KANSAS CITY

REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. III. JUNE, 1879. NO. 2.

ARCHÆOLOGY.

ARCHÆOLOGICAL EXPLORATIONS IN TENNESSEE.

BY PROF. F. W. PUTNAM, PEABODY MUSEUM.

During the month of September, 1877, as stated in my general report (p. 203), friends in Nashville tendered to me such facilities for archæological research in central Tennessee as enabled me to make extensive explorations in several localities, the results of which are briefly recorded in the following pages.*

My first examination of the ancient stone graves, which are so numerous in the state of Tennessee as to form a marked feature of its archæology, was in the pre-historic cemetery of Zollicoffer Hill. It was soon found, however, that the

*Prof. Joseph Jones, in his elaborate and interesting work, "Explorations of the Aboriginal Remains of Tennessee," Smithsonian Contributions, No. 259, 1876, gives much valuable information about the archæology of the state, and describes and figures many articles found in the graves. In this report I do not intend to enter into a discussion of the facts, but simply to give the results of my own explorations in Tennessee. This limitation is also advisable for the reason that large collections, made under my direction, have been received from the state since the close of the year covered by this report, which will be referred to in the next Annual Report. I must, however, state that it was most gratifying to me, on reading Prof. Jones' work, which, though dated 1876, was not received at Cambridge until October, 1877, after my return from Tennessee, to notice how our similar explorations had led to the collection of nearly identical material, and of the corroboration I had obtained of many of the facts which Professor Jones has so well presented; although, as would be expected from two persons having nearly identical material in hand, but looking upon the evidence furnished from different stand points, I am forced to differ from him in some of his conclusions, particularly so in regard to the evidence of syphilis prevailing in this old nation of Tennessee. Undoubtedly very many of the human bones show the results of disease, but it may be that the disease was not syphilis, and that other diseases effect the bones in a similar manner.

graves at this place had been so much disturbed as to make any work done here rather unsatisfactory as to results. The building of Fort Zollicoffer on this hill was probably the first cause of disturbance of the cemetery, while its easy access from Nashville has recently led many curiosity hunters to the spot.

One of the graves at this place had been opened by a friend a few days before my visit, and in it he had found the remains of what he believed to be a mother and child. The few bones he collected and kindly gave to me, however, showed conclusively that while those belonging to the adult had been long buried, and were probably those of the body for which the grave had been made, those of the infant were on the contrary of a much later date, and were evidently of a child that, not many years ago, had been placed in this old grave, which was near the surface and formed a handy place for burial. This fact is mentioned simply to show the caution with which such examinations must be made in order to secure trustworthy results.

One grave which I opened at Zollicoffer Hill, though only a few inches under the surface, had escaped former disturbance. This grave was formed of six slabs of stone on one side and five on the other, with one slab at the head and one at the foot; forming a grave five feet eight inches in length, inside measure, and six feet outside; the average width being eighteen, and the depth sixteen inches. The side stones were unevenly broken to dimensions of eight to fifteen inches in width by about twenty inches in depth, and two or three inches in thickness. The two stones forming the head and foot of the grave were larger than those on the sides. All these stones extended a few inches below the floor of the grave, which was made by placing thinner and smaller pieces of stone in such a manner as to form a level bottom to this cist. Five slabs of stone, larger than those on the sides, rested on the nearly even edges of the upright stones, and, slightly overlapping, formed the cover or top of the grave.

Further examinations in other localities showed that all the stone graves were made after this plan, the only variation being in the size of the stone slabs and in the dimensions of the graves. Any rock was used that could be easily detached in slabs of convenient size. The most common to the localities I visited were limestone and sandstone.

In the grave I have described, the body had been laid on the back and extended at full length, occupying nearly the whole length of the grave, showing that the person when living was about five feet five inches in height.

From many measurements of graves taken during my explorations, I am convinced that the people buried in these stone graves in Tennessee were of ordinary stature. Occasionally a grave seven feet, and even eight feet in length, was found, but in such cases there was always a space of several inches between the bones of the feet and the foot-stone, and between the skull and the head-stone.

In the grave specially mentioned above, the only articles found were fragments of two vessels of clay, which had been placed in the center of the grave, and a pointed implement made of deer's horn (11830).

In another grave of the same character and about the same size, located by the side of the first, and also with the covering stones in place, the remains of the skeleton of an adult were found, and with it, in about the center, on one side of the skeleton, were the fragments of an earthen dish. On the breast of this skeleton was the ornament of copper here figured of its actual size (Fig. 1). The cross-like form of this ornament may give rise to the question of its derivation; and had any article of European make, such as glass beads, brass buttons, etc., so common in Indian graves subsequent to contact with the whites, been found in any one of the hundreds of graves which I opened in Tennessee, I should consider the form of this ornament the result of contact with the early missionaries; but, from the total absence of articles denoting such contact, I think it must be placed in the same category with the "tablet of the cross" at Palenque, and be regarded as an ornament made in its present form simply because it was an easy design to execute and one of natural conception.*

Fig. 1.

11832

Ornament of Copper, from grave on Zollicoffer Hill. Natural Size.

The ornament is evidently made from a piece of native copper hammered and cut into shape. The small perforation at the upper border still contains a fragment of the string by which the article was suspended, preserved by the action of the copper; and on one surface of the copper are slight evidences of its having been in contact with a finely woven fabric, thus showing that this ancient people, who were well advanced in the ceramic art, also possessed the knowledge of weaving.

On the estate of John M. Overton, Esq., eight or nine miles south from Nashville, there was formerly an extensive cemetery, and many graves are still to be found about the hill on which stands Mr. Overton's hospitable residence, known as the "Traveler's Rest." At this place Prof. Joseph Jones obtained many of the articles which he has described and figured in his valuable work.

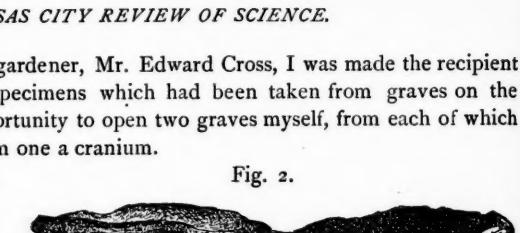
It was my good fortune to receive the kind attentions of Mr. Overton during a short visit to this interesting locality, and, thanks

*Prof. Jones mentions finding the cross represented in several instances upon articles of shell and of copper found in the graves he examined, and has discussed the question of its origin. (1 ch., p. 77.)

to Mrs. Overton, and her gardener, Mr. Edward Cross, I was made the recipient of several very valuable specimens which had been taken from graves on the place, and also had an opportunity to open two graves myself, from each of which I secured pottery, and from one a cranium.

One of the articles of pottery (11835) is here represented, of one-half of its natural diameter (Fig. 2). This is a well made, rather thick dish, without ornamentation, and was found by the side of the skull.

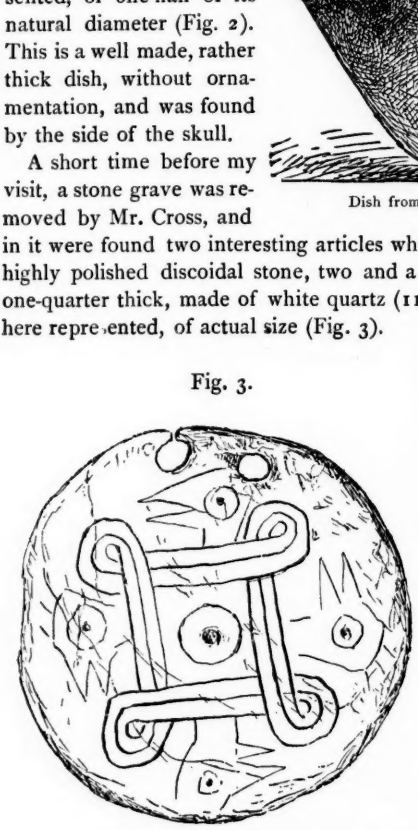
Fig. 2.



Dish from grave on J. M. Overton's place. ½.

A short time before my visit, a stone grave was removed by Mr. Cross, and in it were found two interesting articles which he gave to me. One of these is a highly polished discoidal stone, two and a half inches in diameter and one and one-quarter thick, made of white quartz (11818); the other is the shell ornament here represented, of actual size (Fig. 3).

Fig. 3.



Ornament of Shell from grave on J. M. Overton's place. Natural Size. (11817.)

This ornament is made from a large marine shell, probably a *Busycon*, and is symmetrically carved on the slightly concave surface, as shown in the figure.

The four heads of birds, resting on the rectangular central figure, are represented by simple incised lines. Two holes near the edge of the disk indicate that the ornament was suspended.*

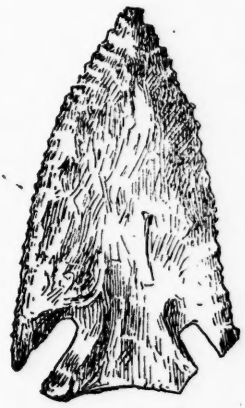
Mr. Cross also gave me a spear, or arrow-point, of jasper, with serrated edges (11819), which is represented of actual size (Fig. 4). This flint-point was found while cultivating the land in the vicinity of the graves, and with two polished celts (11816), presented by Mrs.

*Since this was sent to press there has been received at the Museum, from Mr. E. Curtiss, half of a shell disk found on the surface in Humphreys county, Tennessee. This shell disk has carved upon it figures identical with those on the one described above from Overton's farm. The two localities are between seventy and eighty miles apart, and at both places the number of stone graves indicates large settlements. Can these carved shells be regarded as totems? Several distinct patterns are now known, of each of which two or more examples have been found.

Overton, were probably once inclosed in graves which had been destroyed in former years.

In connection with the shell ornament found in the stone grave on Mr. Overton's place, I give the following illustration (Fig. 5) of a similar ornament (11801), which was given me by the venerable Col. J. D. Morgan, of Nashville, in whose possession it had been for some time. Col. Morgan was not certain that this ornament was taken from a stone grave, though the probability is that it was so found, in the immediate vicinity of Nashville. This disk is made from the shell of *Busycon*, and is larger than the one given me by Mr. Cross. Figure 5 represents this ornament, of one-half its diameter, and will give a better idea than words of the design carved upon it. Like the other, it has two holes for suspension.

Fig. 4.

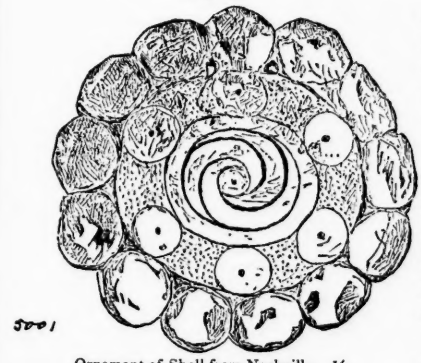


Flint-point from Mr. Overton's place. Natural size.

Prof. Jones has described and figured (p. 43, figs. 7 and 8) a shell disk, found in a stone grave on the banks of the Cumberland, opposite Nashville, the carving on which is identical in its design with that on the one here figured, the only difference being in the number of circles in the two groups. In Prof. Jones' specimen the outer ring contains fourteen circles, and the inner nine, while in our specimen there are thirteen and six respectively. The central spiral figure is the same in both.*

Many of these carved disks of shell have been found in the graves and mounds of Tennessee and Missouri, and, with the identity of the associated pottery from the two localities, go far to prove the unity of the people, notwithstanding some slight differences in burial customs.

Fig. 5.



Ornament of Shell from Nashville. ½.

On the farm now owned by Miss Gertrude Bowling, about four and a half miles southwest from Nashville, were five burial mounds, which, thanks to the kind permission of Miss Bowling, were thoroughly explored. Of these, I personally conducted the work on one of the largest, which was about fifty feet in diameter and be-

* In relation to this central figure, Prof. Jones has ventured, on p. 137 of his work, a comparison between what he calls the "Symbolic divisions of the circle by the ancient stone grave race and mound builders of Tennessee," and the "Chinese figure Taeheih."

tween five and six in height. A second and part of a third were examined by Mr. Curtiss under my direction *

These five mounds, containing the graves of from six to eight hundred persons, were probably the burial places of a former settlement in the immediate vicinity, all other traces of which had long since been destroyed by the cultivation of the land. Not far from this locality, as I was informed, are the remains of a cemetery where the graves were located on the side of a hill. A well known mineral spring is situated within a half a mile of the mounds, and a small winding creek is near by. The locality must have been a desirable one for a permanent village, and, like all other such sites met with in the state, was well chosen for the natural advantages offered.

In the mound which I explored, over two hundred bodies had been placed, with one exception, in stone graves of various sizes. The single exception of a body buried without the care which was used in all other burials in the mound is of interest, especially as there was no indication that any article had been placed with the body, and while engaged in carefully getting out the skull of this skeleton, I could but feel that it was that of some poor outcast, who had not been considered worthy of a stone grave. The skull of this individual is noted in the table of measurements, on p. 224, under No. 11918, and belongs to the ordinary type of skulls from the graves.

The mound itself was formed by several irregular layers or tiers of stone graves, the lowest of which had probably been placed irregularly round the grave first made. These lower graves were formed by making an excavation sufficiently deep to support the side-stones of the grave, but not so as to cover the overlying top-stones, at all events not more than an inch or two. On the graves offerings of food, etc., probably had been left, which would account for the many fragments of pottery, the several stone implements and other articles found upon the covering stones, and by the sides of the graves.

Below several of the graves, near the center of the mound, and, as nearly as could be determined, on the original surface of the ground, was a bed of ashes several inches deep, in which fragments of pottery and a few bones of animals were found. In at least two of the mounds near this, corresponding beds of ashes were noticed. Over this bed of ashes were several graves, the stones of which they were formed extending but a few inches into the ashes, thus showing that these stone graves were often formed above ground. After these early graves were covered by a few inches of soil, a second tier was placed above them, and eventually this was followed by a third and fourth.

At the highest point of the mound a few graves were found, which, though nearly destroyed by the growth and falling of trees, probably belong to the latest, or fifth tier of graves.

Over the mound was a recent growth of trees, the largest of which was a black walnut, standing on the very center with its roots reaching down the sides

* Major Powell and his party explored the other mounds.

of the mound and penetrating some of the upper graves. This tree was eight feet four inches in circumference at its base, and seven and one-half feet at a height of four feet; but as a section of the trunk only showed between sixty-five and seventy rings of growth, the tree is not of value in estimating the age of the mound, for it is historically known that this region was without Indian inhabitants one hundred and fifty years ago, and, uncertain as we are as to the period when they were constructed, it is certainly safe to state that the mounds were not made after that date.

The mound, formed in the method stated, by the gradual accumulation of the stone graves, was conical in shape, as each irregular tier of graves had a smaller number than that below it. The lower graves were thus, of course, the oldest, though there was little difference in regard to the condition of the bones, and the contents of graves side by side in any of the layers were in entirely different degrees of decay.

It was noticed that no method was followed in placing the head of the body in any particular direction, though in the lowest tier the majority were placed with the head toward the center of the mound, but even among these oldest graves one was occasionally found at right angles to that adjoining, In the upper layers, the graves were placed in all directions; sometimes one would be found lying lengthwise directly over a grave below it, and others were resting crosswise upon two, three or even four graves in the tier below. It was particularly noticed that, without regard to the proximity of other graves, each was constructed perfectly independent of those adjoining, notwithstanding the fact that the side or head stones of adjoining graves were often in contact. Generally, however, there was a space of about six inches between the graves, and often the space was one or two feet.

The following transcript of my field notes, for two days of the six that I spent with my diggers in examining this mound, will give sufficient details to show the character and contents of the graves in this and the adjoining mounds. In designating the several tiers, the lowest is counted as the first, and so on to the fifth, or most recent. The graves here recorded were principally on the eastern side of the mound.

Grave 1. 1st tier. Inside measure, 6 feet 9 inches in length, 1 foot wide, 9 inches deep. An adult, body extended, lying on back, head to west. Bones of skeleton very dry. Skull taken out perfect, but fell to pieces in cleaning, pieces saved with all the teeth. Took out large bones, part of pelvis, vertebræ, etc. Fragments of a pot, a broken arrowpoint, and three flint chips in grave. Top of grave covered by four large slabs which projected over the sides.

Grave 2. 1st tier. A child of four or five years, body extended, head to west. Skeleton all gone except portions of the left parietal and occipital, several teeth and piece of femur. No article in the grave. Length 3 feet 9 inches, width 11 inches, depth 9 inches. Side rocks extending several inches below the bottom of inside of grave. Two rocks on top.

XUM

Grave 3. 1st tier. Grave of an old person, body extended, head to west, 6 feet 9 inches long, 1 foot 8 inches wide. Skull, pelvis and long bones taken out in good condition. Nothing but skeleton in the grave.

Grave 4. 1st tier Adult, body extended, head to west, 6 feet 6 inches long, 2 feet 2 inches wide. Took out skull in pieces, long bones, fragments of pottery and shell of Unio.

Grave 5. 1st tier. This grave, though 6 feet 6 inches long and 2 feet 1 inch wide, was that of a youth or a woman of delicate frame. With the exception of portions of the long bones, the skeleton had nearly decayed. No articles in the grave.

Grave 6. 1st tier. 3 feet long, 2 feet 5 inches wide. A young child, all the bones decayed except the shafts of the long bones of arms and legs. No articles in grave.

The grave of an adult, designated as No. 1, was between the two graves of children, Nos. 2 and 6.

Graves 7 and 8. 3d tier. These graves were close together, of same size, the indications being that they were made at the same time. Each grave was 2 feet by 1 foot 4 inches, and each covered by a single slab. No. 7 contained bones of an infant in such position as to show that the body had been extended when placed in the grave. Several of the bones in a good state of preservation, and were saved. In this grave found fragments of pottery and a mussel shell.

In No. 8, the bones of the head and body were in a compact mass of 12 by 6 inches, and had the appearance of having been buried in a bundle. In this grave were also fragments of pottery.

Grave 9. 1st tier. 7 feet long, adult, long bones, pelvis and under jaw saved. A ring of pottery 1½ inches in diameter resting on under jaw.

Grave 10. 1st tier. That of a child, 3 feet long, 1 foot wide. Part of skull and the long bones saved. No articles in grave.

Grave 11 1st tier. Adult, 7 feet long. Skull and long bones saved. No sign of pottery or articles of any kind.

Grave 12. 2d tier. Long grave. Skeleton too far decayed to save any portion. No articles in grave.

Grave 13. 2nd tier. 3 feet 8 inches long, 14 inches wide, 9 inches deep. A child about five years old. Long bones and under jaw saved. No articles in grave.

Grave 14. 3rd tier. 2 feet long, 9 inches wide, 7 deep. That of a child. Portions of the skull and long bones saved. No articles in grave.

Grave 15. 2nd tier. 7 feet long, 11 inches wide, 6 inches deep. Adult, body extended on back, head to north. Skull, long bones and pelvis saved. The following articles were found in space between the skull and headstone:

Large spear point and knife of flint, several flint chips, two awls made of deer's horn, and two others made of bone, a shell bead, tooth of a beaver, tooth of a carnivorous animal, wing-bone of a bird.

XUM

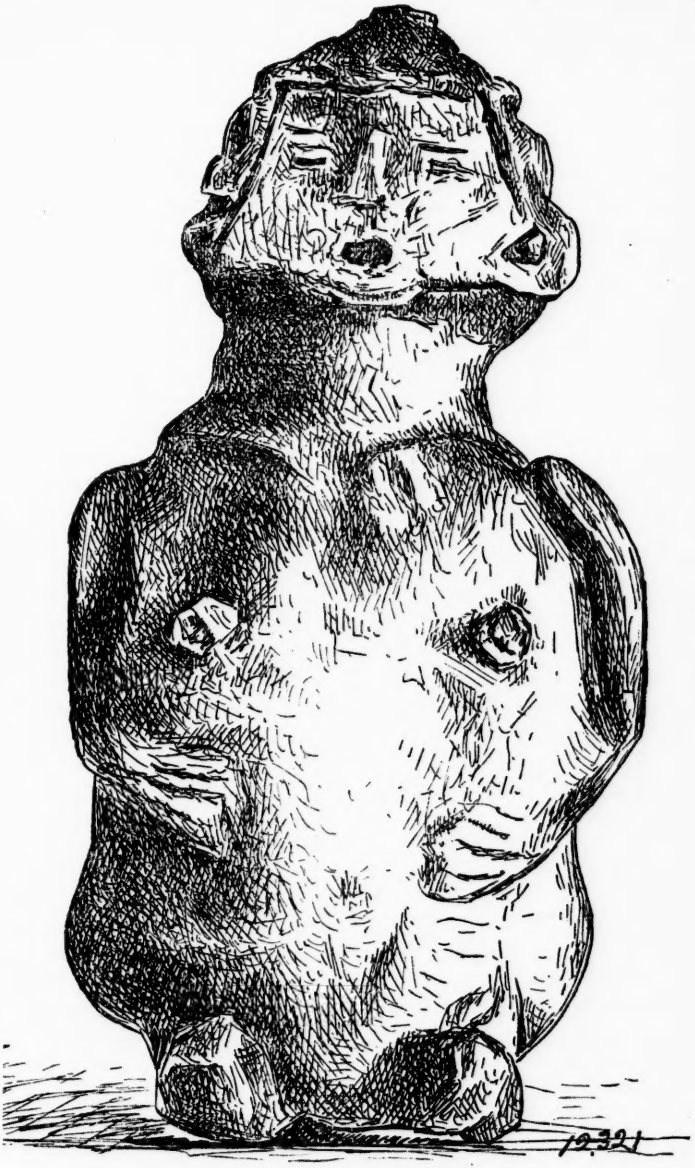


Fig. 6.

Grave 16. 2nd tier. Next west of 15 and of about the same size, head to north. Long bones and jaw saved. Fragments of pottery.

Grave 17. 2nd tier. Old person, head to west. Skull, long bones, pelvis and other bones saved. Two flint chips in grave. No signs of pottery.

Grave 18. 3rd tier. Small grave containing portions of much decayed skeleton of a youth. Shell of Unio, and a flint chip in grave.

Grave 19. 4th tier. On the western side of the mound and the upper tier at this place. The covering stones of this grave had been disturbed. Head to west, feet toward center of mound. Nothing saved.

Grave 20. 1st tier. In part under Nos. 15 and 16. Youth of about 18 years. Jaw and arm bones saved. A slender flint drill, fragments of pottery and a few flint chips in grave.

Grave 21. 1st tier. About in center of mound and running north and south. 6 feet long, body extended, head to north. Skull saved. No articles in grave.

Grave 22. 1st tier. 6 feet three inches long. In same line with 21, and the headstones of the two graves in contact. Head to south. The skull and some of the long bones saved. Flint chips in grave.

Grave 23. 1st tier. Grave of a child, 3 feet 2 inches long, 12 inches wide, 5 inches deep. Head to west. Bones much decayed. None saved. No articles in the grave.

Grave 24. 1st tier. On the same line with grave 23. Footstone of 24 in contact with headstone of 23. Two tiers of graves over 23 and 24, the graves resting on 23 and 24 lying east and west, while those in the upper tier were lying north and south. The position of this grave and the condition of its contents, mark it as one of the oldest in the mound, though on the eastern side of the center. The grave was very dry and the bones had nearly all been reduced to dust. What remained consisted of a few teeth, a fragment of the femur, small fragments of the tibiæ and portions of the spongy part of a few of the bones. A pipe made of pottery and a few flint chips, were found near the teeth, and had evidently been placed near the head.

From these notes it will be seen that from comparatively few of these old graves can either crania or other bones be obtained, and those that are removed require long and patient work. It will also be noticed that very few graves contained pottery or other articles, though this would not indicate any neglect on the part of friends, as it is probable that many perishable articles were placed with the dead in the graves, while the numerous fragments of the pottery, the stone implements, etc., found among the graves, as already noticed, suggest that offerings were placed over the graves, as well as within them.

On the southern side of this mound, owing probably to its being always comparatively dry, the pottery was in a better state of preservation, and numerous perfect specimens were obtained from the graves. In two instances, one on the southern, and the other on the western side of the mound, there were double

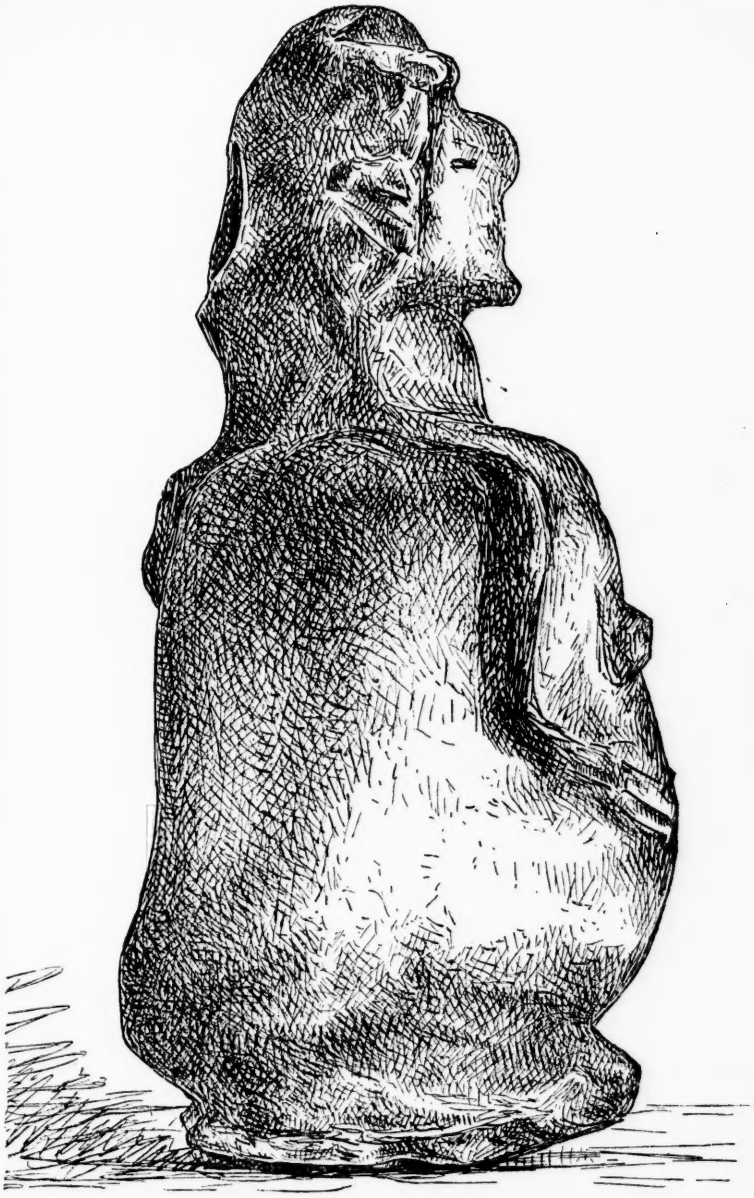


Fig. 7.

graves. That is, two bodies had been placed in a grave of the usual length, but wider than ordinary. In one of these, the skeletons were extended at full length and crossed each other, the skulls being at opposite ends of the grave. In the other the skeletons were side by side, but one of them was without the bones of the feet

In several instances the skeletons in graves which were about two feet square, were those of adults, and showed by the compact arrangement and confusion of the bones, which were out of all natural connection, that the bones must have been buried after the flesh had decayed. Such instances were probably the burial of bones brought from some other place.

The finding of two distinctly marked forms of crania from this mound, and other stone-graves, seems, to me, to show that while the ordinary form of the crania of this stone grave people was such as would bring them among the short-headed nations, they were, by intermixture with a long-headed people, often of the orthocephalic type, though individual variation would also cause many heads of a purely brachycephalic nation to pass into the orthocephalic. The presence of several dolichocepalic crania among the others that were collected from the stone graves, furnishes data suggesting the intrusion of that form.

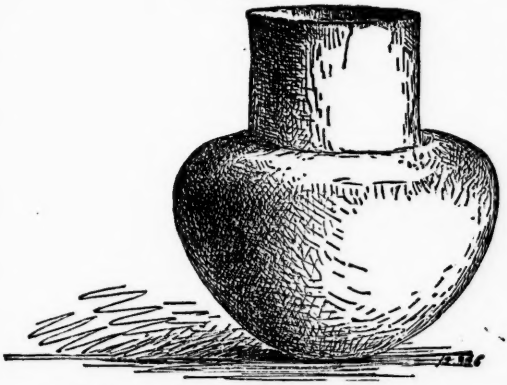
Several bones collected in this mound show the effect of disease of some kind, and are such as would be generally called syphilitic; but several pathologists who have examined them unite in stating that they do not prove the existence of syphilis, as other diseases than syphilis might leave such effects.

The following summary of the collection obtained from this mound, in which about 250 persons had been buried, will convey an idea of the contents of the graves, and I may add that the other mounds on Miss Bowling's farm yielded a corresponding amount of material of the same character:

Portions of fifty-four different skeletons, including many long bones of arms and legs, six sets of pelvic bones, and twenty-five skulls; twenty-four whole or nearly perfect vessels of pottery, nine lots of fragments of pottery from the graves, fifty-nine pieces of considerable size picked out of the dirt outside of the graves; nine stone implements from the graves and seventeen outside of them; eight lots of flint chips from as many different graves; two awls made of deer's horn, four made of bone; four teeth of animals, two of which were perforated for suspension; two shells of turtles; one wing-bone of a bird; one animal bone; all from graves; six spoons made out of shells of fresh water mussels (*Unionidæ*), thirty shells of Unionidæ and five lots of *Melania*; two lots of small shells, *Olivella*, perforated; four small lots of shell beads, all from graves; one pipe, made of pottery, from a grave; two rings made of stone, found in one grave, and one made of pottery, found in another.

The pottery is generally well made, though some vessels are much ruder than others. It is usually of a dark gray color, and composed of clay mixed with finely pounded mussel shells. As a rule very little attempt at ornament was made on the vessels from this mound and others adjoining, and only one of the peculiar

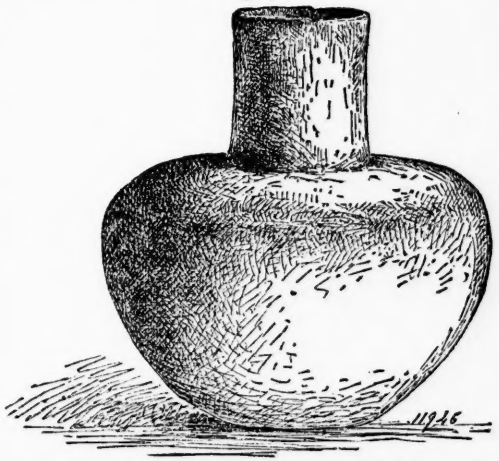
Fig 8.



Jar from Stone-grave Mound, Miss Bowling's farm.

human-shaped vessels, so characteristic of the pottery of this class, was found in the mound. This water vessel, or "idol" as these vessels representing the human form have been designated, is of special interest from its very rudeness of construction and the manner in which the hair or head-dress is represented. The two views of this vessel (Figs. 6 and 7), representing the front and profile, of natural size, give a far better and more accurate idea than could any description. As will be noticed in figure 7, the opening of the vessel is at the back of the head, and the woman is represented as resting on her knees. This rude attempt in plastic art must not be considered as a fair example of the artistic capabilities of this people, for there are several other vessels modeled after the human form, in the collection from Tennessee now in the Museum., and among them is not one so rude and uncouth as this.

Fig. 9.

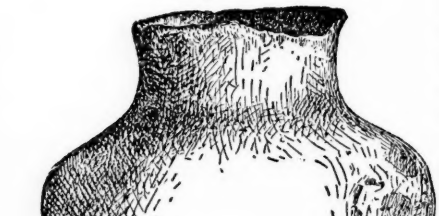


Jar from Stone-grave Mound, Miss Bowling's farm. .½.

In direct contrast to this grotesque figure are the two beautiful and symmetrical vessels here represented (Figs. 8 and 9), one-half their diameter. These jars are made with care and skill; their good proportions and well made curves equaling, and closely resembling in outline, some of the best of the early forms of the Old World which were produced by the aid of the wheel, while their very simplicity is perfection of the art. Smooth and well finished, and standing firm and steady, they are in every way superior to the usual vessels of this character which have been taken from the graves and mounds of the southwestern states, as shown by the two following examples of the ordinary

type (Figs. 10 and 11). The vessels represented by 8, 14 and 15 were taken from graves in mound 2, on Miss Bowling's place; all the other figures, here given, represent those found in graves, in the mound of which special mention has been made in the preceding pages.

Fig. 10.



Vessel from Stone-grave Mound, Miss Bowling's farm. ½.

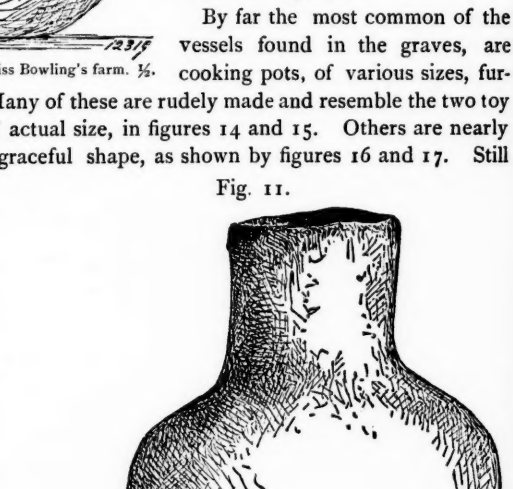
Another and very common form of vessel from the stone graves, is represented by figures 12 and 13. These are comparatively well made cooking pots, furnished with holes, through which strings were probably passed, by which the vessels could be suspended.

By far the most common of the vessels found in the graves, are cooking pots, of various sizes, furnished with two handles. Many of these are rudely made and resemble the two toy vessels which are shown, of actual size, in figures 14 and 15. Others are nearly symmetrical and of more graceful shape, as shown by figures 16 and 17. Still better, and exhibiting a higher degree of workmanship, is the one represented in figure 18.

Figure 19 expresses an early style of ornamentation, consisting of a line of punctures, which give relief to the waved outline of the body of the vessel just below the neck.

Other forms of vessels were also found in this mound, some of which were dish and bowl-shaped, like those figured farther on, from the Lebanon mound, and the one from Mr. Overton's, represented by figure 2, which is a common shape. Among the fragments from outside the graves, and particularly in the ash bed, were several of a thick and rude character, evidently of large cooking pots.

Fig. 11.



Vessel from Stone-grave Mound, Miss Bowling's farm. ½.

(To be Continued.)

THE ANTIQUITY OF MAN.*

BY REV. L. J. TEMPLIN.

The doctrine that man had existed on the earth only about 6,000 years had been so long believed and so universally accepted that there seemed to be little or no disposition to call its truth in question. But this quiescence has been rudely startled by the announcement that recent research has brought to light human relics and fossils that demand for their explanation a lapse of time amounting, according to some, to tens of thousands, and, according to others, to hundreds of thousands of years. It is not the part of wise men either to accept or deny the truth of statements purporting to be based on facts, without a careful examination of the facts in question. While the fact that a new theory or doctrine contravenes old-established opinion is no justification for its hasty rejection, it is a good reason why all the facts in the case should be subjected to the crucial test of the most searching investigation. In approaching the subject of the duration of man on the earth, therefore, we should strive to divest ourselves as far as possible, of all prejudice arising from education or association, and give to every fact bearing on the question a fair, candid, but critical examination, and accept the conclusions that fairly result, whether they accord with the notions we have previously entertained or not. An investigation of the subject, in the spirit I have indicated, will doubtless require a modification of those views that regard man's existence on the earth as not exceeding less than 6,000 years, allowed by the Usherean chronology, while those that hold a period of human existence amounting to many hundreds of centuries will have to abate much from their claim to so great an antiquity for the human race. While making this concession, I do not wish to be understood as detracting one iota from the divine authenticity and truth of the biblical record. What is commonly received as the "Bible chronology" is only man's uninspired inference from certain genealogies that we have reason to believe are not, and that probably were not intended to be, perfect. Our interpretation of these Scriptures may require revision to correspond with the facts of science as well as the true meaning of the record, as has been the case in other instances.

The evidences of the pre-historic existence of man in Europe and America consist of relics of various rude manufactures, such as rough pottery, stone implements, broken bones and shell heaps; of rough drawings of extinct animals, and of human fossils, either in ancient geological strata, or in connection with the remains of certain extinct animals. The human period is divided into three ages, designated by the kind of material used in the manufacture of weapons and implements, as the Stone, the Bronze and the Iron ages. The Stone age is also divided into the Paleolithic, the Reindeer and the Neolithic eras. The first of these indicate a time when the manufactured implements were rudely

* Read before the Popular Science Club of Hutchinson, Kansas, March 12, 1879.

made of unpolished stone; in the last, they were of polished stone, with other evidences of a more advanced state of civilization. The Reindeer era seems to have been a period when a second glacial condition drove the animals and people of Northern Europe southward, where many of them left their remains embedded in the sedimentary deposits of that time. Some of the oldest relics of man are found in certain peat-beds of Denmark. These vary in depth from ten to thirty feet. In these, at various depths, are found embedded the fallen trunks of different kinds of trees. At the greatest depth are found logs of the Scotch pine—*Pinus Sylvestris*—a species that was extinct in that region at the beginning of the historical time. This was followed by a sessile variety of the common oak, and this by the common beech, the only one known in history to belong to that region. Beneath the logs of the Scotch pine, at the lower part of these bogs, certain stone implements have been found that seem to prove that man existed there at the time this timber flourished in that region. How long a time it would require for the growth and disappearance of these successive forests, and for the accumulation of these beds of peat, we have no means of knowing; but that a few thousand years would give all the time needed, appears highly probable, from the rate at which such changes are taking place at the present time.

Another class of memorials of man's early existence in Northern Europe, is found in the shell-heaps, "kitchen middens," found along the shores of the various Danish islands. Some of these mounds are as much as 1,000 feet long, 200 feet wide, and ten feet high. They are made up of the shells of oysters, cockle, and other mollusks, together with the bones of various existing animals, and of birds and fishes; and occasionally scattered through these are flint hatchets, knives, and other instruments of stone, bone, horn and wood, with pieces of pottery, but no bronze nor iron.

Similar shell-mounds are found in the United States, from Maine to Florida, and in the Mississippi Valley, especially near Keokuk and Cedar Rapids, and on the Des Moines River, in Iowa. These consist of the refuse of such mollusks and other animals as are found in the adjacent waters. That these last are of very ancient date, we have no satisfactory evidence; but that those of Europe reach back to a very remote antiquity, is inferred, from two facts: First, that these mounds are not found along the shores of the Western Ocean where the waves are continually eating into and carrying away the land and burying it in the depths of the sea; where it is inferred shell-heaps were formed as where they are now found, but by the continual attrition of the waters they have disappeared. Second, the shells found in those heaps are thrice as large as the same species existing at the present time in the adjacent waters of the Baltic. From this fact it is inferred that at the time their contents were used as human food, the ocean had a much freer access to the Baltic than at present, and that by elevation the oceanic waters have been so cut off, that the fresh waters of rivers flowing into that sea so predominate as to stunt the growth of these animals and reduce them to one-third their original size.

Whether the facts warrant the conclusion of so high an antiquity as has been claimed, is difficult to determine.

These mounds may have never existed on the shores where they do not now exist; or, if they did, four or five thousand years may have been sufficient for every vestige to have been swept into the sea.

The explanation given of the reduction in the size of the molluscan inhabitants may not be the correct one; a scarcity of food or degeneracy from some other cause may have produced the reduction in size. But if the cause assigned is the true one it does not necessarily prove an antiquity for the people whose feasts furnished the refuse for these heaps anything like so great as has sometimes been claimed. Of this I shall have something further to say hereafter, if space permits. Certain bones dating back to a period previous to the glacial epoch have been found bearing marks and scratches that have been thought to be the product of human hands. But on examination it was found that the same strata that contained these marked bones also held the fossil bones of certain carnivorous animals and fishes, whose teeth leave on the bones they gnaw just such marks as those under consideration. So Miocene and Pliocene man suddenly disappears. Various rudely chipped bits of flint supposed to be intended to serve the purpose of hatchets, knives, spear-heads, etc. have been found at various places on the Somme and Seine rivers in France, and also at Hoxne in Suffolk, England. These are associated with the fossils of an extinct elephant, rhinoceros, lion and cave hyena, besides those of some animals yet living. It has been supposed that the juxtaposition of the bones proves that man was contemporaneous with the other animals named. But there are many doubts about the nature, relations and time of life of these flint chips. Some maintain that they are not of human workmanship at all, but only the result of the action of frost on the quartz rocks. Others admit their human origin but claim there is no satisfactory evidence that human beings lived at the time the animals did. And doubtless, great weight is to be given to the objections to the contemporaneousness of man with these extinct animals. The remains are found in the old bed of the river with every indication that they were deposited under the violent action of water, hence it is reasonable to suppose that the various relics have been washed from entirely different strata, and after being mingled together have been deposited in one common grave.

But while there are reasons for believing that the flint implements of Abbeville, Amiens, and other places fail to furnish evidence of the contemporary existence of man and extinct animals, in other cases there is no room for doubt of this fact, as in some instances, the remains of man are so related to those of extinct animals as to preclude the possibility of doubt that these animals lived in Europe contemporary with man. This is proven in the case of the Menton man whose skeleton was not only surrounded, but covered many feet deep with the remains of the cave bear, cave lion, cave hyena, and others. Without pursuing these particulars further I may sum up my conclusions, from a careful examination of the various facts bearing on the question, as amounting to a conviction

that man came in at the close of the glacial epoch, that he witnessed the retreat of the glaciers from central Europe; that he has seen the Scandinavian peninsula and the British Isles united by solid land to the continent of Europe with the Thames as a tributary to the Rhine; that he has seen the elephant, the mammoth and many other now extinct animals in their native haunts in Europe; and finally that Mongoloid man crossed from Asia to America on an isthmus in the place now occupied by Behring's Straihts. I am aware that such announcements naturally bring up the idea of vast geological time, of which fifty or even hundred thousand years would prove an entirely inadequate measure. We think of these events as belonging to the dim past, beyond the reach of our ordinary methods of computing time. But have we not assumed this vast distance of time rather than proved it? Have we not mistaken darkness for distance, and assumed that our ignorance on this subject was really knowledge? Because vast geological changes have taken place since the Champlain epoch was ushered in, it has been inferred that a time of immense duration has elapsed since the retreat of the ice of the Glacial Epoch from southern and central Europe. But aside from the imaginings of men, what evidence have we of this vast time? The reign of ice has not entirely ceased in our own day.

The ice fields that the Stonefolks saw, perhaps on the Rhine, we witness in Siberia, northern Russia and Greenland. The glaciers still linger amid the peaks and higher valleys of the Alps and neighboring ranges. In our own country their retreating footsteps are still seen among the gulches of the Sierra Nevada and Rocky Mountain ranges, and their buried remains are still found in huge masses of ice in the ice wells of Vermont, New York and Wisconsin. With these evidences before us is it unreasonable to suppose that a few thousand years have been sufficient for the removal of these fields of ice from the low lands of central Europe to their present localities? The same I think may be affirmed of the geological changes that seem to have taken place since man's advent in Europe. It will not do to relegate all these to the distant past, for we are living in the midst of these changes, many of which are slow and uniform while others are catastrophic in their nature. Many gradual elevations and depressions of special localities are going on during our own age. Southern Italy has been subject to vertical oscillations of twenty feet or more within historic times. The Andes have been depressed 220 feet in the last three-fourths of a century. The northern part of Sweden is undergoing gradual elevation. Many changes of this nature are now going on at various localities along the eastern coast of North America. More sudden changes, that produce greater changes in a few hours than the above noticed will in as many centuries, have occurred in quite recent times. We have seen the whole coast of South America lifted up ten or fifteen feet and let down again in an hour. During an earthquake in 1819, 2000 square miles in southern Asia sank and became an inland sea, while adjacent to it a belt of country fifty miles long and in places ten broad was lifted up ten feet above its former level. With regard to the coast on the Baltic we have evidence of a very important

depression since the existence of man. While digging a canal near Stockholm, the workmen came upon a fishing hut at a depth of sixty feet. And as this subsidence is still going on, it seems to stand in corroboration of the theory that at no very distant day, as compared with the immense lapse of time claimed by some, that region stood many feet higher than at present.

Having shown that the geological changes that appear to have occurred since man's advent into the world do not necessarily require such a remote antiquity for their explanation as some have supposed, we next inquire what evidence is furnished of the great antiquity of the human race by this co-existance of man with extinct races of animals. Until quite recently, no evidence existed that man was coeval with any of these extinct races, and it was therefore assumed that they were of very high antiquity; and when it was found that the remains of man and extinct animals existed in such juxtaposition as to prove their contemporaneousness, instead of exciting suspicion that an error had been committed in assigning so high an antiquity to these extinct animals, it was thought to be necessary to carry man back to the remote ages when they are supposed to have lived. But wherefore? Why carry man back instead of bringing the animals forward? There is no necessary reason for assigning animals to a distant antiquity simply because they are now extinct. We are witnessing the extinction of species at the present time. The Maories of New Zealand retain traditions of the extinct birds of their islands. The Dodo, of Madagascar, now extinct, was alive 250 years ago. The Solitaire and the Æpyornis have become extinct in modern times, as has also the whale, once so abundant in the Bay of Biscay. The great Auk, of Newfoundland, and the Labrador duck, seem to have disappeared within a few years past. The American Bison, that but a decade of years ago grazed in countless herds over these plains, and even on the spot where this flourishing city now stands, is rapidly approaching extinction, and unless the government speedily inaugurates some efficient measures for its protection, this noble beast will soon have disappeared from the face of the earth. Now, if, as these facts prove, races of animals are becoming extinct during our own times, the fact that human fossils are found buried in the same grave with many extinct animals of Europe, may just as readily, and with as much show of reason, be explained on the supposition that these animals existed at a comparatively recent period of time, as on the counter-supposition that man existed in the remote ages that have been held by some. The facts in the case do not seem to demand for their explanation a lapse of time so great as to do any great violence to the opinion that has so long obtained on this subject.

An argument much insisted on in favor of the great antiquity of the human race is drawn from the fact that Egyptian monuments prove that about as great divergence between the races had been reached 3,000 or 4,000 years ago, as are found to exist at the present day. It is held that if the 4,000 years that have elapsed since the pictures of the different races were drawn on the

walls of Egyptian temples have produced so little perceptible change as we see, it would require an incalculable number of years to produce the differences that we find existed at that time. This has led many eminent men to the conclusion that the different races are distinct species, and as such, have originated at different times and places. But a law is now coming into very general notice that is capable of explaining the great differentiations that have taken place, without demanding so great a duration of time. It is "that species when first introduced have an innate power of expansion, which enables them to rapidly extend themselves to the limits of their geographical range, and also to reach the limits of their divergence into races." Under the operation of this law, when a new type of animal is introduced it is speedily differentiated into the most diverse forms and characteristics of which it is capable, after which these divergent forms or races will run along in a parallel existence until, by unfavorable changes in the environments, they one by one drop out and become extinct.

Numerous illustrations and proofs of this law might be cited from the fossil history of the past, but lack of space forbids it here. Under the operation of this law, man, when first created, would speedily reach the limits of his capacity for divergence into races; and after having reached these limits the resultant races would continue a parallel existence to indefinite time. Supposing the sons of Noah to have been subject to this law, with possibly this tendency to divergence in a particular direction in the case of each, intensified by inherited peculiarities in their wives, and we have all the conditions essential to the production of all the race differences that are shown by the most ancient of Egyptian records, even assuming that the human family has existed but 6,000 or 7,000 years. There appears to be no necessity for the immense lapse of time that some have felt called upon to assume to explain the differences that exist in the races of mankind.

A similar argument to that based on the existence of different races of men, has been drawn from the great diversity of languages that is found among men. Thus, it has been assumed that languages have been formulated in the order of their complexity of structure. According to this theory, the great families of language have appeared in the following order: 1st, the Chinese; 2nd, the oldest Turanian formation, or Thibetan; 3d, Hamism, the language development of ancient Egypt; 4th, Semism; 5th, the highly perfected and harmonious organisms of language, or Arism. Such is supposed to be the order of evolution in language, resulting in the symmetrical and highly specialized organisms found in the Arabic, Sanscrit, Greek and Latin. Assuming the above to have been the order of development from the simple monosyllabic language of China to the highly complete forms of the Aryan languages, and assuming further, that the slow changes that are taking place in living languages, are a fair measure of the rapidity with which such changes proceeded in the earlier history of languages, the deduction is arrived at that the time essential to the evolution of these highly complete forms of language is to be recorded not by thousands nor even by tens of thousands but by hundreds of thousands if not millions of years.

XUM

But is such a corollary a necessary deduction from the facts in the case? What evidence have we that these languages have followed each other in the order of increasing complexity as antecedent and consequent, or rather as parent and offspring? The declaration is a bare assumption, not only destitute of affirmative proof but also antagonized by numerous facts bearing on the question. As a matter of fact we find all these varieties of language existing coetaneously at the present time. Living representations of all these great linguistic families may be still found in existence. Nor does history show that any of these great families of language ever sustained the relation of parent or offspring to any other. What we find to be contemporary, and to have been so throughout historic time we are under no obligation to believe were ever consecutive. Several modes of linguistic progress may have run their course contemporaneously in the world, their characteristic differences being due to the peculiar genius of the different races of men. The theory that language has grown up by development and accretion from the most simple articulate expressions of emotion, may be the only method that science can take cognizance of, yet it may be true, nevertheless, that instead of being the result of this painful and slow process of development, language was at first received by direct communication from a source of superhuman knowledge. In any case we do not find, in the present structure nor in the past history of language, anything to warrant the assumption of a very remote antiquity of the human race. We have no standard by which we can measure the rate of development or differentiation of a language during its early history, hence, all conclusions drawn from such speculations are fallacious and unreliable.

I have now passed over the ground covered by the discussion of this question, and have given my reasons for the opinions expressed in the beginning of this paper, viz: That the existence of man on the earth, probably extended farther back into past time than the limit assigned in the most popular chronology of the present day; but that the claim for the human race of an existence reaching back through many decades of centuries, seems to be based upon erroneous interpretation of facts, and hence to be destitute of adequate support of proof.

In conclusion, I may say, that there is so wide a difference of opinion among savans, both as to the facts and their interpretation, that it is quite too early to announce any positive conclusion upon the subject, and the honest inquirer after truth may well hold his judgment in reserve and wait for further development of facts.

XUM

ASTRONOMY.

MARS INHABITED, LIKE OUR OWN EARTH.

When, sixteen years ago, I published the last edition of my work—"The Plurality of Inhabited Worlds"—I did not expect to see the speedy confirmation which the progress of astronomy was to give to my essay, by allowing us, so to speak, to put our finger on the manifestations of planetary life. On one hand, those samples of other worlds—the aerolites—have brought us, in their composition, certain elements which play a very extensive *role* in life—such as oxygen, hydrogen, chloride of sodium, and carbon. The aerolite which fell at Orgueil (Tarn-et-Garonne) in 1864, brought us a coaly matter—carburets that are due, like peat, to vegetable remains; the one which fell at Lancé (Loir-et-Cher), in 1872, brought us salt. They had already brought us water in the form of hydrated oxide of iron. The worlds whence these fragments come do not differ, then, essentially from our own. On another hand, by means of spectrum analysis, there has been discovered in the atmospheres of the planets, watery vapor identical with that which produces our fogs, our clouds, and our rains. But of the studies made during these later years, the telescopic examination of the planet Mars offers the most immediate confirmation of the existence of life beyond our globe. This neighboring world, indeed, presents analogies of the greatest similarity with our own. By its situation, we are permitted to observe its surface under the best of conditions for study, and the telescope detects configurations which denote the closest relationship of this globe to the one which we inhabit.

It was through the continued and persevering study of the movements of Mars that Kepler discovered the laws which govern the system of the universe. To me, it seems certain that it is through a study of this same planet the theory will be confirmed which will prove the philosophic crowning of astronomy—that of the plurality of worlds. By this double service Mars will have merited the esteem of thinking humanity, and will, perhaps, be able to have those follies and cruelties pardoned with which the god of war has so long inspired the poor unreasonable *genus homo* which people our earth.

Led by a persistent desire to find in practical astronomy itself a direct demonstration of this great truth of the plurality of worlds, I have specially occupied myself with observations of the planet Mars. I have studied it very particularly at those periods when it passed in close proximity with the earth, in 1869, 1871, 1873, 1875, and 1877. On comparing one with another, of the observations made by different astronomers, I have succeeded in collecting together, in this respect, numerous and decisive documents. The results of these observations and discus-

sions are satisfactory for the solution of the curious problem as to the state of life on the planets. I propose to bring them together here in a special study of the world of Mars, and I hope they will interest all those whose thoughts sometimes love to quit the material interests of earth to soar toward the mysteries of the unknown—toward those silent worlds suspended, like our own, in space, and which seem like so many interrogation points placed in the heavens to excite our curiosity and sympathy.

Our readers are aware that the planet Mars comes next after our own in the order of distance from the sun. Our orbit is traced at 95,000,000 of miles from the sun, and that of Mars at 145,000,000. When the two planets are both on the same side of the sun, the difference that separates them is then only 50,000,000 miles; and this may even decrease to 35,000,000, because neither Mars nor the earth moves in a circular orbit, so that their distances from the sun increase or diminish according to epochs.

In order that the observations of Mars may give good results, two conditions are requisite, besides that of its relative proximity at the time of its apposition: the atmosphere of the earth must be pure at the place of observation, and the atmosphere of Mars must not be cloudy. In other words, it must be while the inhabitants of the latter planet are enjoying fine weather. In fact, Mars is surrounded, like our globe, with an aerial atmosphere which, from time to time, becomes covered with clouds just as our own is. Now these clouds, in stretching out above the continents and seas, form a white veil which hides them from us totally or partially. The study of the surface of Mars in this case is difficult or even impossible. It would be as useless to attempt to distinguish this surface when it is cloudy weather on Mars, as it would be to try to distinguish the villages, rivers, roads and railroads of our country from a balloon while sailing above an opaque stratum of clouds. From this it will be seen that the observation of this planet is not so easy as one might at first suppose. Moreover, the purest and most transparent terrestrial atmosphere is usually traversed by cold or warm currents of air, flowing in different directions above our heads; so that often, during the calmest night, it is almost impossible to make a passable drawing of a planet like Mars, the image seen in the reflector being wavy, tremulous, and confused. In spite of these troublesome conditions, the planet Mars is the best known of all.

The moon alone, on account of her proximity, the constant transparency of her rare atmosphere, and the absence of clouds, has been the object of a more assiduous and more particular study, so that her geography to-day is completely determined. But, after the moon, Mars is the best known of all the stars. No planet can be compared with it in this respect. Jupiter, the largest, and Saturn, the most curious (both more important than Mars and more easy of observation in their entirety, on account of their dimensions), are enveloped in an atmosphere constantly loaded with clouds, so that we never see their surface. Uranus and Neptune are only brilliant points. Mercury is almost always eclipsed, like court-

iers, in the radiance of the sun. Venus, Venus alone, might be compared to Mars. She is as large as the earth, and consequently twice the diameter of Mars. She is nearer us, and may even come within 25,000,000 miles of us. But she has one fault—that of gravitating between us and the sun, so that, at her nearest proximity, her lighter hemisphere being naturally always on the side toward the sun, we see only her dark hemisphere bordered with a narrow crescent (or, more correctly speaking, we do not see her). The result is that her surface is more difficult of observation than that of Mars. So she is in this respect excelled by the latter, which, of all the sun's family, is the individual whose acquaintance we shall form most quickly.

We have already been able to study and map the geography of Mars. The most striking thing on a first examination of the general appearance of this planet is that its poles are, like those of the earth, marked by two white zones—two caps of snow. Both the north and south poles are at times so brilliant even that they seem to extend beyond the edge of the planet, in consequence of that well known effect of irradiation which makes a white circle appear larger to us than a black one of the same size. The ice varies in extent; it becomes heaped up and extends around the poles during winter, while it melts and retreats during summer. Its entire mass occupies a greater superficial area than our polar ice does, and sometimes extends down as far as 45° of latitude; that is, to regions which would correspond to the situation of France on the earth.

At first sight the planet seems to bear some analogy to our own, as regards the division of its climates into frigid, temperate and torrid zones. An examination of its topography shows us, on the contrary, quite a characteristic dissimilarity between the configuration of this globe and that of our own.

In fact, upon the earth there are more seas than lands; three-fourths of our globe are covered with water. It is not the same with the surface of Mars, notwithstanding that attempts have often been made to apply such comparisons to its continental and oceanic divisions. Water does not cover three-fourths of this planet, for there is almost as much land as sea, and the seas are mediterranean. Moreover, several narrow seas, true channels, afford communication between the different latitudes. The continents of Mars are of a yellowish-red shade of color, and its seas present themselves to our eyes under the appearance of grayish-green blotches, their color still more heightened by the effect of contrast with the reddish color of the continents. It is this prevailing color of the land which gives to the planet that ruddy light by which it is at all times distinguished from the other planets and from the fixed stars.

The color of the water on Mars appears, then, to be the same as that of terrestrial water. As for the land, why is it red? It was at first supposed that this tint might possibly be due to the atmosphere of the "warrior planet." It in no wise follows that because the air of our own world is blue, that of other planets should be of the same color. It might be possible to suppose, then, that the atmosphere of Mars was red; and the poets of the planet would, therefore, extol

this glowing shade. Instead of diamonds sparkling in an azure vault, the stars there would be glowing fires blazing in scarlet; the white clouds would be suspended in a red heaven, and the splendors of the setting of centupled suns would produce effects no less remarkable than those that we admire upon our sublunary globe, But there is nothing of this. The color of Mars is not due to its atmosphere; for, although this veil extends over the whole planet, neither its seas nor its polar snows come under the influence of this coloration; and Arago, by proving that the limb of the planet is less colored than the center of the disk, has shown that this coloration is not due to the atmosphere, for if it were, the rays reflected from the edges of the planet in order to reach us, having more air to pass through than those that come to us from the center, would be, on the contrary, more deeply colored than the latter.

Can it be that this characteristic color of Mars, so visible to the naked eye, and which is undoubtedly the cause of the warlike personification with which the ancients invested the planet, is due to the color of the grass and other vegetation which must cover its plains? Can there be red meadows and red forests up there? Can it be that trees with ruddy foliage offer a substitute there for our quiet and delightfully shaded woods; and are our scarlet poppies typical of the botany of Mars? It may be remarked, in fact, that an observer situated on the moon, or even on Venus, would see our continents strangely tinted with a greenish shade. But in autumn he would see this shade disappear in those latitudes where the trees lose their foliage, and afterward would see snow covering the country for entire months. On Mars, the red color is constant, and we remark it in all latitudes, during their winter as well as their summer. It varies only according to the transparency of its atmosphere and of our own. That is no obstacle, however, to the fact of the vegetation of Mars being the principal cause of this general tint. The ground cannot be everywhere bare like the sands of Sahara. It is probably covered with vegetation of some kind or other; and, as it is not the depths of the soil, but its surface, that we see, it must be that the surface-covering—the vegetation, whatever it is—has red for its predominant color, since all the land of Mars offers this same curious aspect. We speak of the vegetation of Mars, we speak of its polar snows, we speak of its seas, of its atmosphere, and of its clouds, as if we had seen them. Are we authorized to create all these analogies? In reality, we see only red, green, and white *blotches* on the little disk of this planet. Is the red indeed *terra firma*, is the green really water, and is the white indeed snow? In a word, is this truly a world like our own?

Yes! Now we are able to assert it. The appearance of Mars varies constantly. White spots move about over its disk, too often modifying its apparent configuration. These spots can be nothing but *clouds*. The white spots at its poles increase or diminish according to the seasons, exactly like our terrestrial circumpolar ice-fields, which would offer precisely the same aspect, the same variations, to an observer placed on Venus. Then these white polar spots of Mars are like our frozen water. Each hemisphere of Mars is more difficult of observa-

tion during its winter than during its summer, being often covered with clouds over its greater portion. This is also precisely what would happen to an observer from Venus, with respect to our earth. Every one knows that the sky is oftener overcast in winter than in summer, and there are entire weeks during which fogs or clouds prevent us from seeing the heavens.

PHILOSOPHY.

IS NATURE PERFECT?

FROM THE LONDON JOURNAL OF SCIENCE.

We have often thought it might be useful to exhibit, in all their well-marked contrast with the results of modern Science, those views of Nature which still prevail even among the cultivated classes, and which are very slowly retiring from the fields of literature. For this purpose let us take a man,—such as may be found in abundance in the middle and upper ranks of society,—well-educated, heedful, thoughtful, and refined, but not trained as an observer, and having no special acquaintance with recent discoveries in natural history. Let us give him a holiday, and send him for a summer ramble in the New Forest, in "merrie Sherwoode," or among the ferny coombs of Devon, and let us try the while to read his musings. Even his very first expression of feeling, the sigh of relief on finding himself rid of city-bustle, worry, and noise, is mainly the outcome of an illusion. He fancies himself in a sphere where boundless resources are dispensed with a liberality equally boundless. The heavens are full of light and warmth, and the earth is clad in rich and varied hues. Perfume breathes from every spray. On all sides is life, animal and vegetable, unworn by toil and unshadowed by care and anxiety. To the butterfly hovering over the blossoms, to the blackbird warbling on the spray, the world seems not as a man, the task-yard of a workhouse, but the banqueting-hall of a palace. The observer, even whilst he envies the insects and the flowers, who "toil not, neither do they spin," feels soothed and refreshed by the mere reflection of their supposed felicity.

Plenty requires peace as its natural complement, and our wanderer believes that he finds this boon also in the woodlands and the heaths. Indeed, how should it be otherwise? Where there is superabundant plenty, where every demand is more than satisfied, how should there be the thrusting, and pushing, and jostling, outward visible signs of that internecine war of each against all, and of all against each, which the "friends of peace" worship under the name of competition? The observer cannot, indeed, forget that in his realms of concord and repose, pain and death are present. He knows that at any given

moment hundreds of flies must be struggling in the snares of spiders; that caterpillars innumerable are being gradually devoured by internal parasites; that many a song-bird is falling a prey to the hawk or the weasel. But, as was the case half a century ago, even with eminent naturalists, he scarcely apprehends the full meaning of all this suffering and massacre. Such facts as we have enumerated seem to him mere "rude exceptions to the general joy," departures from the order of Nature, casual, even though numerous, rather than as they really are, part and parcel of its very essence. Our friend in his ramble, and in his necessarily hasty survey, fails to perceive that not only does one-half the animal kingdom live only in virtue of the death of the other half, but that the herbivorous creature is as much a life-destroyer as the beast of prey, extirpating other animals by depriving them of food, and plants by consuming their seed or their seedlings. He overlooks the silent, quiet, but not the less deadly war waged by plants among themselves, each seeking to monopolize to itself soil, air, and light, and to crowd out, starve, or smother its competitors. In short, in his optimistic contemplations, he entirely forgets that struggle for existence which—whether or not we regard it as a main factor in the development of animal and vegetable forms —we are bound to accept as perhaps the greatest, and assuredly the saddest, feature of the organic world. Who, after reading the third chapter of the "Origin of Species," can fail to be reminded of those words of St. Paul "For we know that the whole creation groaneth and travaileth in pain together until now;" * or of the sadder exclamation of one who, having no faith in the ultimate solution of this dark riddle, cries out in agony "Creation is murder!" †

But not only is strife rather than peace the order of the organic world,—strife so thoroughgoing and so wide spread that it rages even among spermatozoids; not only do the majority of seeds and ova, from one or other cause, fail to be developed; not only does every species press hard on its means of subsistence, or on the space where alone its being is possible. Even in matters where life is not directly concerned we find Dame Nature not lavish, not liberal, but more penurious than the wife of thriftiest peasant-proprietor in rural France. Those colors which so fascinate the poet or the artist, and which seem to be spread in such royal lavishment over copse and meadow and heath, have all their purpose to fulfill; they have to serve as an attraction to insects which effect the fertilization of the flower. The beauty and the odor which we so much admire appear only when this task is necessary, and when it is accomplished they are again withdrawn, just as at a banquet the lights are quenched and the decorations taken down when the guests have departed.

To a sensitive mind it must be saddening to find that the woods, the fields, and the solitudes offer no soothing contrast to the exchange, the workshop, or the battle-field, and that on earth peace, repose, and harmony exist nowhere. But it is the duty of Science to "perceive and declare" whether the facts and the laws recognized be joyous or grievous.

* Romans, viii. 22.
† WINWOOD READE, Martyrdom of Man.

In one sense, indeed, Nature may be called lavish. But it is an unkindly prodigality. She is reckless of life; reckless and wasteful, too, of heat, the prime condition of organic existence. Passing over the fact that the bulk of the solar radiation travels out into the desert depths of space, while an infinitesimal portion alone falls upon any of the planets, very much of the heat which reaches our earth, at least, is radiated off again during the night. Carbonic acid gas, indeed, possesses the precious attribute of admitting the sun's rays freely, and of being at the same time almost impervious to heat-rays of low tension, such as those given off by the earth. But this gas forms but a very small proportion of our atmosphere, and could not be sensibly increased, on account of its injurious action upon higher animal life. But if the non-poisonous gases, oxygen and nitrogen, had the same power as regards the radiation of heat, the climate of the world would be much improved, and spring frosts—the bane of the farmer and the gardener—would be rendered impossible. It is of course conceivable that some cause may exist which renders it impossible for oxygen and nitrogen to possess this attribute without forfeiting their characteristics in other respects.

There is another feature which, outside of scientific circles, we hear commonly ascribed both to the individual animal or plant, to the fauna and flora of any given country, and to the animal and vegetable kingdoms in their entirety. We refer to the attribute of "perfection." We must confess ourselves utterly at a loss to know how this notion has been reached. We have asked believers in this doctrine to tell us by what marks this perfection is to be recognized. We have invited them to take up a plant or an animal, and to demonstrate that any departure from or addition to its present standard, whether structurally or functionally, would be injurious. But the only answer we have received has been a cloud of generalities. The very idea of perfection seems to us unthinkable in reference to a crowd of species engaged, as all Nature is, in mutual conflict. It by dint of the imperfections of the Carnivora in speed, strength, or cunning that their prey—say the deer or antelope—escapes. It is in virtue of the imperfections of the latter animals that they are captured by the wolf or the leopard. Again, were all animals and vegetables perfect in themselves and in reference to their surroundings, we may ask how it comes that so many species have been exterminated, and that others are even now in course of extermination? It may be contended that the surroundings have altered. This, then, is an admission that the adaptation to circumstances is not always perfect. But, further, some other species, or at least groups, coeval with such as have disappeared, are still found surviving. Here we have consequently the following riddle to solve:—Two groups of "perfect" animals, each in "perfect" harmony with its surroundings, are given. These circumstances being altered, the one group is no longer in harmony, and consequently perishes, while the other remains equally well adapted to a different set of conditions, and survives! Yet more; admitting the perfection dogma, we must suppose the fauna and flora of any region—say New Zealand—better adapted to i s soil and climate, and to all other local condi-

tions, than any strange animal or plant can be. On introducing such strange species we should therefore see them placed at a disadvantage, and without constant human aid and supervision prove unable to exist at all. But in reality the very reverse is the case; the new comers are not only found able to exist independently of man's assistance, but to spread in opposition to his most strenuous efforts, and even to crowd out the natives. The notion, therefore, that every local fauna and flora forms a perfect whole, perfectly adapted to the circumstances in which it is placed, must be given up as a most glaring error.

Again, we often see large groups of closely-allied species, differing but little from each other, inhabiting the same country, dependent upon the same enemies. Thus there are in Britian alone fifty-seven species of the small dung-feeding beetles included under the genius *Aphodius*. Some of these are exceedingly abundant, others comparatively rare. If all these species are perfect, and perfectly adapted to environments, why should some be so much more plentiful than others? But, descending more closely to particulars, we may show that in animals, as in man himself, there are certain *desiderata*—wants which Nature has left unsupplied. How exceedingly uncomfortable should we, for instance, feel if we were suddenly deprived of the power which we now enjoy of excluding the light from our eyes when we think proper! Yet as regards the sense of hearing we labour under a similar deficiency; it might rather be said under a greater, since to all persons who have occasion to concentrate their thoughts upon some given subject noise is a far greater nuisance than light can ever be to a healthy man. Surely, then, our inability to render ourselves temporarily and voluntarily deaf is a proof that we, in one respect at least, fall short of perfection.

We may take another instance: what a great addition would it be to man's comfort if he were personally offensive to all insects of the Dipterous order, so that they would keep aloof from him in disgust! When we consider that the mosquito, in addition to the positive irritation, annoyance, and want of sleep which its attacks occasion, is now proved to be an agent in the spread of leprosy,—when we remember that the common house-fly is a propagator at least of ophthalmia, and probably of all zymotic disease,—we surely cannot dispute that such a change, either in the nature of our cutaneous emanations or in the tastes of these pests, would be an incalculable boon, lacking which we cannot proclaim ourselves physically perfect.

Did we know the necessities of other animals as well as we know our own, we might doubtless find in like manner defects on all hands. But we have surely said enough to lead the advocates of organic perfection—who often find in this dogma an *a priori* objection against Evolution—to pause and reconsider the the evidence upon which it is based.

The last of the popular assumptions concerning Organic Nature which we can here notice is the old, but still rampant notion that every plant, every animal, exists with reference to man, and for his convenience. "What use is such or such a creature?" is a question too commonly asked—and not by children

only—of the zoologist or the botanist When we reply that to the best of our belief and knowledge the animal or plant in question is of no use, but simply an unmitigated nuisance, the most charitable construction put upon our answer is that we are too proud to confess our ignorance. Like the doctrine of organic perfection, this dogma is not traceable to any substantial basis, but, having once become a current article of popular faith, its extirpation is proving a difficult task. To us it appears, in its very essence, irreverent. If the Creator had, *e. g.*, made the mosquito, or the guinea-worm, or the *Lucilia hominovora* to be of service to man, we may depend upon it that they would not have been sources of annoyance. Even a human invention, the produce of exceedingly finite reason, is condemned, if, along with certain and even great good, it effects abundant mischief. How much more if the good be problematic, and the evil open and palpable? Shall we, then, adduce what is notoriously defective as an instance of Divine "contrivance"? One thing we may certainly conclude, viz.: that if a maximum of earthly enjoyment and the minimisation of earthly suffering had been the objects of the Creator, the world would have assuredly have been constituted very differently from what it is. When we know what His objects really were it will be quite time enough to indulge in teleology and to indite "Bridgewater Treatises."

METEOROLOGY.

DETAIL REMARKS ON THE WEATHER.

ISAAC P. NOYES, WASHINGTON, D. C.

Men generally seem to think it more of an indication of wisdom to reject or oppose a newly revealed truth, than to accept it; at least they think that new ideas should find their way into public favor very slowly. Fortunately for the human race there are exceptions to this, and that there are always a few men who are quick to perceive a truth, and who at once make themselves ready to become its champions. Their task, however, is not always an easy one; on the contrary it is quite apt to become a thankless drudgery. It is again fortunate that there is such an enchantment about truth that its followers are ever willing to work for small pay—that the mere permission to work in some cause that is believed to be true and for the benefit of mankind is, with some few at least, a great favor.

Notwithstanding the number of years that observations of the weather have been taken, and very satisfactory results obtained, still, very few, outside of those immediately engaged in the work, will interest themselves in the causes that produce the results every day witnessed in the atmosphere about us.

Almost all departments of science have what may be termed exceptions; yet the word "exceptions" hardly presents a fair view of the subject, for these so-called exceptions are not really exceptions, but merely different phases of the subject. Under certain causes certain effects will be produced, but in nature there are always a number of causes working together; under some conditions one predominates, under other conditions other effects, etc. Though this law seems very easy to understand, still there are many people who seem blind to it, and they seem to think that there can be no deviation from the law as they understand it, and their idea of it is that it must have all the precision of an automatic machine, else there can be no value in it. They will not consider the fact that in all nature the strongest force will predominate, whether it be heat, cold, moisture, or dryness, etc. They seem to forget that though the blossoms have their time to appear in the spring, and do generally appear with much regularity from year to year, there are seasons when the heat, for reasons which may be readily understood by studying the weather maps, causes these blossoms to be a little earlier or a little later than common, and that when they appear too early, a cold spell of weather is apt to follow and injure the bud, so that the fruit is destroyed or greatly reduced in quantity. We are liable to have similiar irregularities in the weather department. People who have paid some little attention to the subject, yet not enough to be very earnest after the truth, will often accuse the weather bureau of error, and even doubt the correctness of the system. On the 8th, 9th, 10th and 11th of March, over a large portion of the United States we had a peculiar condition of the weather. In former articles I have referred to a law, resulting from the conditions of low barometer, or what may now well be considered a law, that north winds will be cold and south winds warm. In the vicinity of Washington, on the 10th of March, we had an apparent exception to this law as a whole. It was very warm on the 8th, 9th, 10th and 11th of March, especially on the 10th, and yet on this day the wind was all, or most of the time at least, from the north; first northwest, then northeast—still it was very warm. At first it seemed as though there was a mistake somewhere, for how could the above statement in regard to north and south winds and the center of law be accepted as a law in the face of such evidence to the contrary? To the meteorologist this was not much of a mystery, at least for more than a moment or so, for he knew how it must be—would the weather map support any plausible theory to account for what was by some regarded as one of the great irregularities of the weather, and the laws laid down in regard to it? It was well known on the 8th and 9th, that low barometer was on high line of latitude—up in Canada, somewhere beyond our line of observers. This would readily account for it being generally warm throughout the United States, but hardly for a north wind at Washington. The map for the 10th, which, by the way, is not posted until noon, explained the mystery. First, to repeat, *low* was on a high line of latitude. This warmed the atmosphere all to the north of Washington, so when other causes produced a local north wind it only brought back the warm air that had been heated

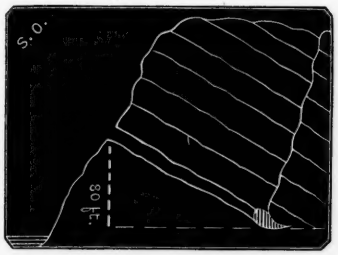
and drawn toward the north during the past two days. Previous to this another *low* had passed off the coast, and was out on the Atlantic ocean. These winds from the north were quite moderate, indicating that the center of *low* was not very concentrated. In the fore part of the day what little wind there was from the northwest, or better, in the direction of the southeast, was toward this what may be termed the *old low* that was out on the ocean. In the meantime the *low* that was up in Canada had developed a tongue-like prolongation, fully half way down into the territory of the United States. By the way, it is not an uncommon thing for regions of low barometer to be developed in this way. As the center of this *low* was far away, or not very positive, it was natural that a sub-center should develop in this tongue of *low*. This in the locality of Washington caused the northeast wind. Such winds, however, are merely local, and though from one quarter, in reality belong to another. Locally this was a north wind, yet in its general aspect it was a southerly wind with a local turn to the south, the same of the Mississippi river which at some local points courses to the north when the current of the river as a whole is toward the south.

Possibly some people may consider this merely an ingenious defense of a natural phenomenon after it has occurred, but fortunately the weather maps will bear witness to the truth of the statement, and it would be absurd for any one to maintain for an instant that it would be possible for these maps to be made to conform with any imaginary conditions of private individuals, who were interested in having certain effects accounted for in a way to please their notions of what ought to be the conditions to produce certain results. Possibly some people entertain such ideas, but a little familiarity with the subject would at once dispel any such notions. Truth is always consistent. An erroneous report could not be made to harmonize with all the complex changes that are constantly occurring. An intentional error of this kind would heap such disgrace upon the person making it as no respectable person could bear. But then no alarm need be apprehended in this matter, for only a fool would attempt it, and his foolishness would be so apparent to the world that his deception could not be carried out—it would only rebound upon itself and expose the ignorance of foolishness that would attempt it, and would be such a disgrace as no man of science would desire to be the author of. So we can depend upon the reports being honest and as correct as the limited number of observations will permit, and that no disturbance of the atmosphere can occur which cannot be satisfactorily explained by these daily maps. Though at first there may seem to be a lack of harmony between the weather and the record, the two will, on careful observation, be found to agree, and will make all exceedingly plain to those who will take a little trouble to examine the all facts.

PARADOXICAL PHENOMENA IN ICE CAVES.

BY N. M. LOWE.*

In the *Scientific American* for March 29th, last, there appeared a letter from Mansfield, Ohio, inquiring as to the cause of the phenomena in an ice cave which is to be found in Decorah, Iowa, and for which there appears to have been, as yet, no cause assigned. A description of this cave is given in the same letter, of which description, so nearly as is possible, the accompanying illustration is a fair representation, as regards the main features of the case.



There may be a few differences as regards the details of the cave, but so nearly as can be judged from the written description the drawing presents the elements necessary to the peculiarities of the cave. In the figure, the cave will be seen represented as at the bottom of an inclined passage, the inclination being that noted in the description, and the dimensions and other particulars being as nearly as possible to the proper scale. The crevice, mentioned in the description, may be imagined as a fault, which extends from the top of the cave to the top of the bluff, through which crevice, mingled air and water finds its way to the cave.

In regard to the mingling of air with a stream of descending water, a quotation from the pamphlet of Mr. Frizzel, on the subject of the compression of air by such streams, would not be entirely out of order. On this subject, he says,—

"It is a matter of common observation that bubbles of air rise in still water with a very moderate velocity. The velocity depends, somewhat, on the size of the bubbles. Bubbles, such as issue from an orifice one-eighth or one-tenth of an inch in diameter, rise from a depth of fifty feet in about fifty seconds, moving rather less than one foot per second near the bottom, and rather more than that near the surface. It is plain that a bubble of air drawn into water that has a downward motion of more than one foot per second, will be carried down and subjected, in its descent, to a continually increasing pressure."

Considering, then, the description and the facts above quoted, it would not be unfair to assume that there would be a possible compression of air contained in the water, on its liberation in the cave, of about eighty pounds to the square inch. This assumption is supported by the fact that from the description, the mouth of the cave would be at least eighty feet above the level of the river, and it may be inferred that as no special mention is made of the position of the entrance, save that it is in the side of a bluff, the hill may be considered as extending above the mouth of the cave to at least the distance of the latter from the river.

*Read before the Boston Scientific Society April 9, 1879.

The phenomenon, then, of ice being found there in the summer, can be referred, I think, to the theory of the liberation of compressed air brought down from a considerable height by a stream of water falling or flowing through a natural conduit or fissure in the rock, embodying the principle of the ancient and well known *tromp* used in the Catiline forge, and still in use in Corsica, Sardinia, Savoy, and many other places.

It is only necessary to imagine such imperfection in the conduit or fissure at the initial point, which is supposed to be on the top of the bluff, or far up the mountain's side, as would admit air to come in contact with the water after it had attained a velocity of more than one foot a second. When the air has reached the bottom and is liberated in the cave, it will be from a pressure equal to the height of the column of water, and it will have lost by *convection* in the mass through which the conduit passes, the heat *due to its compression;* and on being liberated, it will immediately absorb from the air and the water in the cave, the heat which it has lost in its downward passage.

"The most remarkable fact" that the cave freezes only in summer, and as the cold of actual winter comes on, the ice in the cave gradually melts and disappears, is caused, I will venture to state as an opinion, by the gradual freezing of the surface at the top of the bluff or the source of the air, to a considerable depth, thus sealing up the aperture through which the air entered the conduit.

Sir Roderick Murchison described a similar ice cave at Lletski, Russia, but gave no explanation as to the phenomena.

Ice wells are to be found at the foot of Mount Mansfield, in Vermont, and are really incipient caves, without depth enough to be clear of ice in winter, from the fact that the external winter temperature reaches the bottom or source of the summer ice.—*Science Observer.*

A NEW THEORY OF DEW.

Investigations which Prof. Levi Stockbridge has made at the Amherst Agricultural College, upon the comparative temperature of soil and air, and the disposition of dew upon the earth and plants, have led him to conclusions very different from those commonly received in regard to the formation of dew It is usually held that dew is the moisture of the air, condensed through contact with objects of a lower temperature, and that it does not form till radiation has reduced the temperature of the earth and other objects below that of the atmosphere. The experiments referred to seem to indicate that, as regards objects in the immediate vicinity of the earth, at least, the process is the converse of this, viz., that dew is the result of condensation, by the air, of warm vapor as it rises from the soil. The course of experiments from which this novel scientific theory was deduced is outlined below.

The basis of the theory is the discovery that in summer the average tem-

perature of the earth at night is higher than that of the atmosphere. The temperature of the earth in an inclosed space on a level with the surrounding soil, and the temperature of the air, were taken at the warmest time of day and the coldest time of night for several months, and the average temperature of the air for the season was found to be 72.940°, and that of the soil 72.061°. But the average temperature of the air at night was 49.664°, and that of the soil 56.370°, the earth thus averaging at night over 6° warmer than the atmosphere. The temperature of the soil and air at night was also taken at various points within ten miles of the college, on all kinds of grass land and bare soil, and in the forest, and the same facts were obtained, the soil being at all times warmer at night than the air.

These results led to experiments on dew-fall. Two boxes, each of a cubic foot capacity, were filled with soil without disturbing its particles or disarranging its strata; one receiving absorbent, retentive loam, and the other peat. These boxes were placed in a trench, in an open field, level with the surrounding ground, and exposed to the weather. Through the month of June they were weighed night and morning, and unless there was a rain in the night, they uniformly weighed less in the morning than at night, the loss being from one to three ounces for the loam, and one to four ounces for the peat. This, Prof. Stockbridge thought, indicated that the soil at night gave forth water, and that the moisture found on the surface of a field in the morning came from a deeper soil rather than from the air. Other similar experiments followed. In one a cabbage plant was inclosed in an air-tight tin case. Where the stem of the plant protruded through the top of the case, wax was used to make it impossible for moisture to escape through the leaves. The can was first kept within doors and weighed night and morning, when it always showed a loss during the night of 1.21 grams to 1.78 grams. When left out doors at night, with the can wrapped in cloths to prevent moisture reaching it, the loss was from .55 grams to 4.23 grams, showing a loss even when there was moisture or dew on the leaves.

These experiments, continued through the season, gave Prof. Stockbridge these proofs of his proposition that the dew on the ground in the summer is the condensation of vapor that rises from the earth: 1. The vapor of the soil is much warmer at night than the air, and would be condensed by it. 2. Vapor from the soil is soon diffused and equalized in the whole atmosphere, but in largest proportion when evaporation is taking place near the surface of the soil; and, other things being equal, plants nearest the earth have the most dew. 3. Dew under hay-cocks, boards, and like objects on the ground, could receive it from no other source.

METEOROLOGICAL SUMMARY FOR APRIL, 1879.

SIGNAL OFFICE, LEAVENWORTH, KANSAS, MAY 1, 1879.

The weather conditions during April were notably constant, and there were few features to distinguish it from April of past years.

The mean barometer of the month was 29.930, about .05 above the April mean. The highest barometer was 30.404 on the 3d.; the lowest2, 9.444 on the 9th. The pressure during the month was somewhat higher, and the range somewhat less than during the same month of several previous years.

The mean temperature of the month was 55.37°, being 3° above the April average. The highest temperature was 83°, on the 26th, the lowest 19.5°, on the 3d. This was the lowest April temperature recorded at this station during the past seven years. The greatest daily range was 40°, on the 5th, and the lowest daily range 10°, on the 14th and 30th.

The mean percentage of humidity during the month was 55.38. The April average is 60.80%. The ranges were not very great. The highest daily mean was 85.7% on the 14th; the least 28.3% on the 5th.

The total rainfall, during the month, was 3.57 inches, being eighty-three one-hundredths of an inch below the April mean. The greatest April rainfall, ever recorded at this station was 7.65 inches in 1876; the lowest, 1.67 inches in 1875.

The prevailing wind of the month was southeast. Total number of miles traveled during the month, 6,629. Highest velocity thirty-two miles, from the S. E. at 3:15 p. m., 8th. The records of Prof. Snow, at Lawrence University, show that, almost invariably, the force of the wind at that station is nearly double what it is here.

Two hundred and ten observations of the wind's direction were recorded as follows: N. 45 times; N. W. 27 times; W. 4 times; S. W. 4 times; S. 31 times; S. E. 46 times; E. 15 times; N. E. 28 times, and calm 10 times.

Number of clear days during the month 9; fair days 10; cloudy days 11, and days on which rain fell 13.

Among casual phenomana were noted Lunar halo's on 4th, 28th and 29th. Frost on 17th and 18th, and hail on the 6th and 29th.

Prof. F. Hawn, the well-known horticulturist of this city, reports to this office as follows "The condition of the fruit trees, in regard to the coming fruit crop, could not be definitely determined at the close of March. The winter was unusually severe on shrubs, trees and plants; not so much from the low thermal range as from the protracted low mean and other atmospheric conditions, such as relative humidity, etc. March added greatly to the injury, as on the 7th the thermometer marked up to 83°, and for six days the mean was over 55°. This developed the buds to a vulnerable point, and started a flow of sap that proved fatal to many trees and shrubs. Following this came the low range of March

24th and 19th at 9° and 15° respectively, and the high ranges from March 25th to 29th inclusive, the thermometer on each day making over 70°, and on the 27th up to 84°. This warm wave was followed by another low range on April 3d and 4th, the minimum temperature being 19.5° and 21° respectively. The extent of the damage, produced by these great ranges of temperature, could not be then estimated, and which the blooming season of the latter part of April developed. Peaches, early apples, pears, apricots and Duke cherries will be almost a total failure, and many other species greatly damaged."

The following table will aid in a comparison of the past month with April of previous years:

Year.	Mean Barometer.	Mean Thermometer	Mean Humidity.	Total Rainfall.	Maximum Temperature.	Minimum Temperature.	Highest Barometer.	Lowest Barometer.
. . . . .		deg's.	per c't.	inches.	deg's.	deg's.		. . .
1872	29.910	56 21	. . .	3.63	84	29	30.440	29.280
1873	29.851	48.60	62.40	5 07	85	26	30.262	29.315
1874	29.999	49.00	62.10	2.80	82	22	30.365	29.389
1875	29.961	49.80	55.20	1.67	82	23	30.345	29.546
1876	29.909	55.24	60.90	7.65	85	31	30.349	29.500
1877	29.838	53.30	64.90	7.14	80	25	30.476	29.112
1878	29.687	58.80	59.30	2.86	80	35	30.126	29.088
1879	29.930	55.37	55.38	3.57	83	19.5	30.404	29.444
Average of 7 Years.	29.879	52.99	60.80	4.40	82.6	27.3	30.338	29.319

Samuel W. Rhode,
Signal Corps, U. S. A.

MISSOURI WEATHER SERVICE—APRIL, 1879.

PROF. FRANCIS E. NIPHER, DIRECTOR.

April, 1879, has been cool and dry. The mean temperature, at the Central Station, has been 55.15° (normal, 56.1°). The extremes of temperature were 25° and 82.5°. Although the average temperature was but little below the normal, the minimum (25°) was unusually low for April. Engelman has, however, observed lower temperatures several times—as low as 18° in 1857, while in 1833, '43, and '55, the thermometer marked 93°.

The rainfall at the Central Station was 2.69 inches (normal 3.70 inches), while the rain for April, 1878, was 6.31 inches.

In the State, the rainfall was greatest (over 3 inches) in a belt reaching from near Hermann to beyond Sedalia, reaching a maximum of 4.33 inches at Sedalia.

Along the Missouri river, from Kansas City to Oregon, the rainfall also exceeded 3 inches. Over the greater part of the State, the rainfall was from 2 to 3 inches. In general, the deficiency of rain in the State, as compared with last year, is about 3 inches. The drouth occurring in the latter half of the month has extended over the eastern half of the State.

On the 14th, when the center of low pressure was near St. Louis, a rain began at noon near Chamois. This rain extended outward, with great regularity, in all directions, with a velocity of about 20 miles per hour, increasing in violence to the west and east, and diminishing to the north and south of Chamois, as is shown on the map to accompany this bulletin. The rain was accompanied with thunder and lightning, and, in the most cases, with hail. In the Mississippi bottom, a few miles east of St. Louis, several tornadoes were developed (at least *four*), the tracks of three of which intersected in the village of Collinsville, Illinois, at about 2:45 P. M., causing great damage. These vortices were unaccompanied by lightning, rain or hail. A careful study of these tornadoes has been made by Dr. J. L. Wadsworth, of Collinsville, and the results will be published in detail.

On the same day, at 3:15 P. M., a heavy wind from the southwest, lasting 3 or 4 minutes, with 0.2 inches of rain in 3 minutes, and hail enough to cover the ground, was observed at Centerville. The thunder accompanying was violent, and high in air, with no lightning visible.

The wheat crop is generally reported as very promising. Fruit, and particularly peaches, considerably injured.

Washington University, May 5, 1879.

WEATHER REPORT FOR APRIL, 1879.

BY PROF. F. H. SNOW, OF THE KANSAS STATE UNIVERSITY.

STATION—Lawrence, Kansas, corner of Tennesee and Pinckney streets; elevation of barometer and thermometer 875 feet above sea level, and 14 feet above the ground; anemometer on the University building, 105 feet above ground.

Mean temperature 56.4 degrees, which is 2.89 degrees above the April average of the 12 preceding years. Highest temperature 84 degrees, on the 22d; lowest, 20 degrees, on the 3d. Mean at 7 A. M., 50.03 degrees; at 2 P. M., 66.23 degrees; at 9 P. M., 54.73 degrees. The severe frost of the 3d, was very destructive to fruit buds of peaches, pears and early apples.

Rain, 4.18 inches, which is 0.96 inch above the April average. Rain fell on 10 days. There were six thunder showers and two light hail showers.

Mean cloudiness 49.67 per cent., the month being of just the average clearness. Number of clear days, 11 (entirely clear, 5); half-clear, 9; cloudy, 10 (entirely cloudy, 4). Mean cloudiness at 7 A. M., 53 per cent.; at 2 P. M., 51.33 per cent; at 9 P. M., 44.67 per cent.

Wind—N W., 22 times; N. E., 21 times; S. W., 16 times; S. E., 15 times; S., 7 times; E., 5 times; N., 3 times; W., once. The entire distance traveled

by the wind was 11,231 miles, which gives a mean daily velocity of 374.37 miles, and a mean hourly velocity of 15.48 miles. The highest velocity was 50 miles an hour on the 9th. On the 10th, the total run of the cups was 1,010 miles.

Mean height of the barometer, 29.062 in.; at 7 A. M., 29.084 in.; at 2 P. M., 29.033 in.; at 9 P. M., 29.069 in.; maximum, 29.467 in. on the 3d; minimum, 28 684 in., on the 14th; range 0.783 in.

Relative humidity—Mean for the month 61.0; at 7 A. M., 71.5; at 2 P. M., 40.8; at 9 P. M., 70.1; maximum, 96.5 on the 30th; minimum, 18.3, on the 4th.

GEOGRAPHICAL NOTES.

SECOND ANNUAL REPORT OF THE DIRECTORS OF THE GEOGRAPHICAL SOCIETY OF BREMEN.

TRANSLATED FOR "THE REVIEW" BY CAPT. H. W. HOWGATE, U. S. A.

The following is a recapitulation of our Society's operations in the past year:

The utilization of the results of our exploring expedition to Western Siberia, is most worthy of mention. As you will recollect from our last year's annual report, February 1, 1878, the collections are not only in Bremen, but also in Hanover, Hamburg and Brunswick, and have been brought to the notice of the German public in that categorical and concise order which so distinguished the Bremen Exposition.

The 51st assemblage last fall, in Cassel, September 11th to 17th, of the naturalists and doctors, gave rise to the conclusion to bring these collections before a larger circle of scientific men. The aid of the Scientific society in that city (and especially of its manager, Dr Hornstein) was thus secured.

Dr. O. Finsch again undertook the manifold duties of assorting and arranging the collections in the handsome apartments of the Royal Art Gallery (first floor, new building), which were tendered by the city authorities for this purpose, gratis. Our member, Capt. H. Sengstacke, offered in a most praiseworthy manner to assist Dr. Finsch in his laborious duties, and to act as representative for the society, during the whole duration of the Cassel Exposition, which lasted five weeks, and the attendance at which was an animated one.

Over 8,000 persons visited our Siberian Expositions at five German cities, and though the financial results show only an excess of 371 marks, after deducting all expenses, still we point with satisfaction to the result obtained, and which has been our sole aim, i. e. the dissemination of geographical knowledge. It may be mentioned here that the ethnographical collection has been enhanced by the addition of five photographs—in cabinet form—and two stereoscopes, which first appeared at M. G. Behrens' in Brunswick.

* * * * * * *

A contract has been entered into with publisher E. Wallroth, in Berlin, to issue the work of the Siberian expedition, and which may be expected to make its appearance in about two months It will consist of forty sheets of print and fifty-six illustrations, thirty-five of which latter will occupy a full page each, and the remaining twenty-one will be printed in the text. These illustrations have been drawn from nature by Dr. Finsch, and will, therefore, be correct in the smallest details.

* * * * * * *

Our society, according to last year's annual report, comprised 117 active, 9 corresponding and 9 honorary members. At present it consists of 146 active, 16 corresponding and 13 honorary members. Three died, viz: Drs. Meinertzbagen, Petermann and Kohl. The deplorable loss which science has sustained by the death of the two latter mentioned excellent geographers, has been commented upon by the press in a consistent manner.

* * * * * * *

Not wishing to enter into details of geographical facts, which accumulated in 1878, still we must notice the unexpected result obtained by the Swedish Polar Expedition, which, according to last advices, after going north of Asia to the mouth of the Lena (August 27th), have pushed forward almost to the entrance of Behring's Straits, thus solving the one hundred year old problem of the north-east passage. It is hoped that the heroic members of that expedition will succeed this summer in steering their vessel safely to the shores of Japan. At all events, expeditions are being prepared by land and sea to trace them. Among the latter is our honorary member, Mr. Alexander Sibiriakoff, who has trusted the management of his new steamer "Nordenskjöld," to a German seaman i. e. Henry Sengstacke, formerly 1st Lieutenant of the German North Pole expedition vessel "Germania," and assuredly the difficult task of carrying the first vessel from the Atlantic Ocean to the mouth of the Lena could not have been trusted into better hands. Mr. Sengstacke is a practical seaman of long experience, and took a prominent part in the German North Pole Expeditions 1868-70. He is rendered competent also by numerous studies at the German Naval Academy to be the theoretical leader of an expedition which must furnish important nautical and hydrographical results.

Last year we had to record the death of our member, Edward Mohr, while on a new exploring tour to Central Africa. To-day we are forced to record another loss i. e, the death of Dr. Christian Ruterberg, of Bremen, in western Madagascar. This young scientist started last fall from Madzunga, accompanied by ten natives, to the western part of the Island. The sad catastrophe occurred in the Province Menski, as per dispatches received. The details of this tragic event are not known, as yet. It was Dr. Rutenberg's intention to return to his home after this last tour, and we had hoped he would assist in the labors of our Society and to so compensate, in a measure, for the two above named gentlemen who are now forced to leave Bremen.

ESQUIMAU DOG DISEASE.

In a recently published official document upon the results derived from the English Arctic Expedition of 1875–6, is an interesting paper on the Esquimau dog disease, by Fleet Surgeon B Ninnis, M. D., of the Discovery, from which we extract the following portion:

"Twenty five apparently healthy dogs were embarked on board ship, in the middle of July, 1875, subsequently increased to twenty-seven by the addition of two young ones. We were given to understand that feeding twice a week was amply sufficient, that the worst possible personal treatment was too good for them, and that meat, in any stage of decomposition, was a perfect luxury to their fastidious palates.

Seven-and-twenty animals confined to a space which the utmost attention was scarcely sufficient to keep habitable, constantly quarreling and fighting for dear life, exposed to sun, snow, dew and wet generally, and without a chance of a run ashore, it was not to be wondered at that they began to show signs of disease. The first attacked was a young female, twenty-five days on board, and she had a fit and died in thirteen days. Others became attacked. One was summarily shot, one ran away and was seen no more, two were accidentally drowned, seven died from the disease, six recovered, and one died mad.

Of the whole number, twelve only were under medical treatment, one had rabies and died, one so far recovered as to have two litters of pups, and then died ten months after her first fit, and two or three days after her last litter. Two fell into the water when in fits and were drowned, two died notwithstanding everything that was done to cure them, and six recovered and were landed at Disco on our return.

The symptoms were disinclination to move, accompanied by a very contracted appearance of the loins, which, however, were not tender to the touch, tenesmus, and scaly, pitchy stools. These symptoms were followed in two or three days by a fit with foaming at the mouth. No disposition to bite.

As the disease progressed the fits became frequent and altered somewhat in character. Instead of lying quietly on their side only slightly convulsed, the fits lasted about a minute, then leaving the animal apparently as well as before. The animal now struggled violently, the head thrown far back, spine curved deeply in, the tail curled over the back almost touching the head, legs stretched out, teeth exposed, violent contraction of the muscles of the chest, rendering the cavity greatly reduced in size and thus arresting respiration.

These fits sometimes succeeded each other rapidly, and left the dog so exhausted as to be scarcely able to move, and he finally died in one of the fits. The post-mortem examination showed healthy brain spinal cord, heart, lungs, liver, pancreas and kidneys. The chest in all cases was exceedingly contracted and the lungs collapsed, and in all cases where the intestines were examined, they were found to contain the pitchy substance noted above as forming one of the

earliest and most certain symptoms of the disease, and also ulcerations of the inner surface of the gut to the extent of at least four inches on either side of the ileo-cœcal valve, which, in some cases, was found covered with coagulated blood.

The treatment found most beneficial, and which I recommend, is, on the first signs of pitchy stools or tenesmus, give four grains of calomel, followed by croton oil, if necessary, and repeated at intervals until the stools become more natural. If there appear to be much uneasiness, or if the animal whines, I have given forty minims of solution of morphia, and kept him under its influence, repeating the dose every four hours if necessary.

As the patient is generally hungry, I prefer to keep him from roaming and give him the best of water and good food in small quantities and frequently. I think if taken at this stage, very few would die. As the disease advances, there is less time for the action of medicine, therefore, larger doses and more active measures must be used.

In conclusion, I consider the ulcerations on the intestines quite sufficient to account for the symptoms. The cause of these ulcerations would be difficult to trace, but the effect of such, acting as an irritant to the nervous system, and causing convulsions, is, in my opinion, a highly probable circumstance.

DANISH EXPLORATION IN GREENLAND.

Lieutenant Jensen, of the Danish Navy, left Denmark for Greenland, last month, on another surveying expedition, accompanied by Lieutenant Hammer, also of the Danish Navy. Lieut. Jensen will return to Europe in the Autumn, but Lieut. Hammer is directed to remain at Jacobshaven for the winter, in order to investigate the remarkable ice-fiord near that place. Dr. Steenstrup, who left Copenhagen, in 1878, on a scientific expedition in Greenland, remained at Umenak last winter, and is expected home in the Autumn of this year.

EXPEDITION TO THE CONGO.

The Rev. T. J. Camber, of the Baptist Missions, left England for the Congo, April 26. Ascending the river as far as the foot of the Yellala Falls, he will proceed by land over his old track to Makuta, and thence strike for "Stanley Pool" above the falls. A small steamer in sections, will follow by the same route for use on the waters of the Middle Congo, should his mission be successful. The Royal Geographical Society has supplied Mr. Camber with a fair outfit of astronomical and meteorological instruments.

Dr. Stewart's paper is illustrated by a map, and contains much valuable data. He reports that steam navigation already exists by the "Lady Nyassa" on the lower Zambesi, and by the "Ilala" on Lake Nyassa. The latter vessel will

probably be replaced shortly, by one still larger. There is only one broken link in the chain of communication now between the London docks and the Rombashe—that is, the seventy miles of the Murchison Cataracts on the Shire.

The "Journal" of the Royal Geographical Society for May, contains leading articles as "The second circumnavigation of Lake Nyassa," by Dr. Stewart; "Journey along part of the western side of Lake Nyassa in 1878," by the Rev. Dr. Laws, and "Notes on the physical geography of Zulu land and its borders," by Rev. George Blencowe.

By the steam packets of the Union Company, or the British India Company, it is possible to sail now from this country to Zanzibar or Quilimane, and thence, by the two small vessels already mentioned, to the north end of Lake Nyassa. Two years ago, the journey on the river and lake had to be made by canoes.

In the discussion in Dr. Law's paper, the statement was made on the authority of the agent of the Church Missionary Society, that no death had yet occurred in eastern Central Africa from *fever*, they had all been from dysentery, and the suggestion was thrown out for African travelers that the one staple of diet should be rice.

CORRESPONDENCE.

SCIENCE LETTER FROM PARIS.

PARIS, FRANCE, April 12, 1879.

For the safety of many towns and villages, and for the protection of many laborious populations, the planting trees on the mountains, to counteract torrents, has become a necessity in certain parts of France. The idea appears to be exploded that the felling of forests has no influence on inundations. Planting trees, following climate and altitude, and inducing grass to grow, are the measures adopted by the French government, and are in a sense compulsory or optional for proprietors. The aim is to anticipate the formation of destructiveness by consolidating the soil, and suppressing the effects of torrents, by extinguishing them—that is, drying them up. It is not intended actually to abolish the torrent, but to cause it to pass into the volume of a stream, to prevent its carrying down earthy matter, and producing certain floods. By protecting the soil against the mechanical effects of rain, by regulating the currents, by dividing them, inundations can be avoided. In planting trees, the object desired is to obtain a forest,

not a wood; here time is necessary and necessitates a certain movement of surface soil, of humus. For the temperate zones of mountains, the trees to be selected can afford no difficulty, but for Alpine regions, only spruce, larch and fir can be chosen—and larch above all, as it admirably resists atmospheric influences, requires no support, adapts itself to all soils, and has the faculty of throwing out new branches from old bark. Except in elevated regions, where the tree must be fir, and planted, it is an open question whether the plan of sowing or planting ought to be preferred. In any case where the latter is adopted, the trees cannot be too young. In laying down to grass, the idea must not be assumed of forming a perfect meadow, but of sowing wherever practicable, and of taking care in those districts where the pasture cannot be mown but fed down, not to allow the sheep to enter on the soil too early in summer, nor to remain too long in autumn.

M. Vogt draws attention to the fact, that migrations, whether active or passive, constitute a general and unexceptional law, as much for mammiferous animals and reptiles, as for birds and fishes, only the conditions are slower in one case than in another. It is in their young stage that sedentary animals, and those fixed to the soil, or attached as parasites to the bodies of other animals, migrate; it is thus the young coral and sponge swim; in parasites, on the contrary, the female and male insects migrate, while the young and the larvae remain where the egg has been deposited. Between locomotion and migration there is only the difference of space to depart and return from two fixed points; a snail would require ages to traverse the distance that a pigeon accomplishes in a few minutes. To change place then, an individual or species will require a period of time proportionate to its ability to move; generations supplement the brevity of single life, and time does not count in science. In the case of a new garden, insects will arrive there before snails. In Europe there has been a slow migration of mammiferæ, birds and reptiles, from south to north, as well as from east to west. It is since 1827, when the great Russian rat crossed the Volga, that it has destroyed the indigenous species, and is in a fair way to do the same in America. Wolves have invaded Europe, as hyenas and jackals Africa, as a consequence of wars and great calamities. The pretended instinct of the migration of birds is due to the stimulus of hunger. The birds make their nests where they find food for their young; hence they come northward because southern climates are too dry for insects during the summer. Similar migrations take place in the sea. In the neighborhood of the poles these are particularly notorious, the animals following the movements of the ice; seals, great whales, white bears, the musk buffalo, advance northward in summer and southward in winter, following the caprices of the ice and the accumulation of the snow. It is by this migration that animals become indigenous in a country where at first they were simply travelers, and next pioneers. To seek food is the grand stimulus of change. Inaccessible mountains, wide and deep rivers, deserts, etc., may retard migrations, in some instances obstruct them. Thus, on the other side of the Amazon, there is a different race of monkeys. Wolves have been extirpated

in England since two centuries, and the Straits of Dover impede those from the continent to cross over. Indian tigers can swim across the arm of the sea which separates Singapore from the mainland. Certain animals migrate not only to seek food, water, a more temperate climate, but also to satisfy the wants of reproduction. The latter is the motive that impels cod, herrings, tunny salmon, etc., toward "banks" in such vast shoals as to displace for miles the animals peculiar to the locality. Forget not that the migrations which take place before our eyes to-day, are the consequence of the same laws that have produced those in past ages, and as revealed by geology.

Instinct, for Descartes and many others, was simply a gift bestowed by nature at the moment of an animal's birth. According to science, instinct is merely an hereditary habitude. Thus, migration is the habitude, as with birds, for example, to search food. The stock comes southward in winter, because the aquatic food on which it lives, is inaccessible by the ice. No migratory bird ever selects an unknown path; it remembers ever the road it will have to retake, for physiologists demonstrate, birds have a marvelous power of perception; no matter how distant a bird may be from a forest, or how dense may be the latter, it knows the hollow tree wherein is its nest. In time of migration the cloud of birds is ever led by the oldest, and it is no less true, that those birds which stray from the main body and are taken are always the young—the ninnies.

Scientists are intensely occupied with the electric light; new systems are constantly being made known, or old ones improved. M. Janin, professor at the Sorbonne, has described an ingenious system. The principle of the electric light resides in the formation of a "voltaic arc," between two charcoal conductors, placed at a suitable distance; the ends of these two sticks of carbon burn and become incandescent; between them is a band of fire, less brilliant when the current is intense, than the sticks themselves; this band is composed of particles of matter of an extreme tenuity, through which also a current passes, circulating between the positive and negative poles. Magnets have an important influence on these currents, attracting and repelling. Now M. Janin employs the carbon sticks to cause the voltaic arc to blaze upwards like a flame of gas in giving them the properties of magnets, by alternately repelling and attracting the current. The carbons, further, never can be extinguished. Master of directing the arc, M. Janin, had to seek how to make it more brilliant; this he has effected by applying the means for imparting brilliancy in the case of the Drummond light, employing a morsel of chalk or magnesia. M. Janin uses a piece of chalk in the form of a hat, the jet entering beneath; the arc is thus crushed, as it were, and expends less power than if the hat were not there. More important still, the light, instead of being radiated toward the sky, and largely wasted, as in the Jablochkoff plan, is reflected on the ground—the lamp can thus be greatly elevated. The Janin light has not that sepulchral hue, so peculiar to electricity, the latter having too many violet rays, and so will be in favor with the ladies. In

a word, the system lies in the chalk, kept in a state of incandescence by the voltaic arc.

Electricity has also been applied to the unwinding of silk from cocoons. A workman must be very skillful to find on ordinary occasions the end of the thread when broken; by the new invention, the thread passes between two metal plates, and separates them. When the thread breaks the plates come together, a current is generated which communicates with a spring, and thus instantaneously stops the machinery.

Beans in Italy are attacked by a curious insect called *bruche*; on an average there are two insects for each bean—one half of the crop being affected. There is this peculiarity, the germination of the bean is never affected by the malady, the enemy not touching the germ.

The Sirocco is the warmest of winds, and is felt severely in northern Africa, and also in Sicily and southern Italy. Its coming can be predicted by the reddish orange tinge of the atmosphere, indicative of atmospheric dust. The rain clears the atmosphere of every kind of dust, hence why the astronemers select the period after rain as most favorable for their observations. Professor Ricco, of Naples, has examined the sand of the Sirocco, which comes from the deserts of Africa, and he finds it rich in the well-known and peculiar spherical atoms of iron. Where did the iron come from—or where does it originate, as it is found everywhere, possessing the same characteristics? These spherical atoms, the same that fall when flint and steel are struck, are to be found in the most ancient rocks; sea sand contains them in vast quantities; they are present in snow, in glaciers, in geological sediments; an anchor taken from the bottom of the sea wil be found eaten by rust. Now these atoms are never rusty. Science has no certain explanation to give as to their origin or their formation.

In 1878 croup and diphtheria attacked the inhabitants of Marseilles like a plague. At the same time it was observed that barn-door fowls were similarly affected. M. Nicati inoculated healthy fowls and rabbits with the disease, and the subjects of the experiment duly sank under the malady. These facts are in connection with the important problem of fermentations, which are the grand source of ruin and death. They engender disease, kill the living being, and disorganize animal and vegetable tissue. Fermentations are produced from animalcules; these microscpic creatures penetrate our tissues, absorb our blood—devour us. After death they effect our decomposition. We want to discover a substance that will kill these enemies without injuring ourselves. M. de Cyre maintains that we have found such an agent in pure borate of soda, that sold in commerce is adulterated with lead, alum or carbonate of soda. It is an inoffensive salt, destroys the germs of maladies, and is strongly anti-putrid. Small quantities of the salt in powder preserves meat, butter and milk from alteration, and without changing their appearance or altering their taste. Professor Panum, of Copenhagen, recom-

mends the use of the borate in place of ice as an agent of conservation. He has fed dogs during twenty-four days on meat preserved by the salt, the food remained fresh-looking and highly nutritive, the dogs becoming markedly fat.

Many believe that the horse is of Oriental origin and accompanied the Aryan immigrations Europewards from Central Asia—the accepted birth place of the human race. The ox has played an important part as a civilizing influence, as also the sheep, in transforming man from a hunter to a shepherd, and next, to a laborer. But it is to the marvelous organization of the horse as a motive power —it is by his strength we measure the force of steam engines, that man has been able to become an *industriel*. Professer Ecker, of Germany, maintains that the horse exists and has ever existed in a savage state, in Europe, not as in the pampas of South America, where the wild horses are the descendants of imported ancestors. The horse is not only the most remarkable but the most ancient of domestic animals, its remains having been found associated with pre-historic man. But the horse was then hunted as game, its head and bones as found with those of reindeers in caves, were selected to extract the brain and the marrow, as the Esquimaux practice at the present day. The tail was employed for its hair, but the remainder of the carcass was abandoned. The wild horse of the quaternary period has been domesticated, as the wild boar has become a pig. The remains of the pre-historic horse of Solutrĕ, in the Lyons Museum, corresponds in resemblance with the wild horses of Westphalia, Bavaria, and Russia of the present day, small, stumpy, and large headed. Later the Asiatic horse arrived by the Mediterranean, and his larger form altered the native races.

Messrs. Cumenge and Fuchs have found that in some quartz where the gold cannot be extracted by amalgamation, the cause is due to the presence of antimony, just as silver is united frequently with arsenic.

A manufacturer in the environs of Paris refines large quantities of petroleum. He observed that his workmen were peculiarly healthy and robust, in being exempted from catarrhs and consumptions, while the contrary was the case in other factories. The poor flocked to receive a daily dose—spoonful of petroleum daily, more produces diarrhœa, and were relieved of coughs and colds till the apothecaries interfered and compelled the philanthropist to cease illegally curing. The remedy is still preserved, as the faculty now prescribe petroleum in the form of capsules.

The grey oil cloth used in lining perambulators has been condemned; the varnish contains a great deal of arsenic, and when it chips babies eat it and die of convulsions.

M. Dieulefait's experiments establish that lithia is as plentiful in rocks and waters as potash and soda, and M. Bonnier concludes that many plants have nectaries wherein no nectar is secreted at all.

MEDICINE AND HYGIENE.

HOW TO PREPARE FOR SUMMER.

With the return of spring and warmer weather, it is not too early to direct attention to the various disinfectants in common use. It should be remembered that the first action of the summer in our temperate climate is not to be considered at all in proportion to the actual heat developed. There is a peculiar chemical action in the sun rays, which, most especially in the spring, appears to engender rapid decomposition. No matter how thoroughly a house is constructed, indifferent as to the skill of the plumber, necessary precaution should be exercised. Automatic traps, no matter how ingeniously contrived, will lose their self-regulating powers, and as they are concealed, no one can ever tell at what moment they may really be doing more harm than good in the house. Just as soon as cold weather is over, a careful housekeeper should examine the condition of the cellar. If there be leaks or admission of moisture in the cellar, it is more likely to be visible, now that the furnace is no longer in operation, than during the winter. It is as well to look carefully at the exact places where the drain-pipes from the closets enter the cellar. In some cases these may be built into the wall and are not visible. Good architects, with sound sanitary views, hold in horror any contrivances having to do with the health of the inmates where there is no chance of seeing or knowing whether deleterious gases are being filtered through the house or not. Many a sad accident occurs in a house where the fault is sought below the ground, when it actually exists mid-way. All typhoid fever does not exist in badly drained neighborhoods. Its sporadic character may often be traced in good neighborhoods, in carefully constructed houses, from the careless indifference of housekeepers, who will not keep their eyes about them. Cellars should be well cleaned by the end of this month. An accumulation of ashes may hide or keep in abeyance a mass of corruption, caused by servants, which becomes a source of malaria when warmer weather sets in.

One great source of health in a house is the free use of water, wherever it is found. Flushing a room wherever there is a wash-basin, even if it be an untenanted chamber, should never be neglected. If all the rest of the stationary wash-basins or sinks in the house are in use, this is all the more a reason why the one not in use should be the most dangerous one in the whole house. It is perfectly easy to understand that exactly there the mephitic gases will be formed and escape, because there is no waste to absorb them. Plumbers will tell you, and wisely that a current of hot water, from time to time, should be sent, even in warm weather, through all the basins in a house. The reason is simple.

Quite solid deposits made of soap or animal grease coat the pipes, which are only dispersed by hot water. A kitchen sink, though much hot water be passed through it, always wants, because it receives more grease and vegetable matter, both in winter and summer, some disinfectants. The simplest, and one which can be used at the lowest cost, is to dissolve the common sulphate of iron of commerce in water, a pound to a bucket of water, and use in all those parts of the house where water is turned on. The action of the sulphate of iron is purely a chemical one without antiseptic properties. All it does is to deoxidize the decomposing substances. Nitrate of lead, more expensive, is also a very safe disinfectant. The permanganate of potash acts even more rapidly than the salts of iron or lead. Of late years the use of carbolic acid as a disinfectant has not been so much in vogue. Its influence seems to be more local, acting rather on the atmosphere than the source from which the decomposition arises.

It may be taken as a rule that, in attempting to purify a house, it is of little use to attack the atmosphere. The vitiated air, though breathed and containing the poison and the germs of disease, renews itself over and over again, faster, perhaps, than it can be corrected. A saucer of chloride of lime in a room may destroy the poisonous gases. But it is the source itself which must be sought and corrected. Strike at that, purify that by destroying the cause, and the effects must pass away in time. The use of iodides and bromides in a house is accompanied by so many drawbacks as not to be recommended. Some old methods, as used on board of ships, are excellent. A room in which a fever patient has been confined, may be rendered salubrious, and the germs of all disease killed, by burning sulphur in the room, at first having, of course, removed all the furniture, otherwise it would become rotten and bleached. There ought not to be, even with a defective sink, a bad atmosphere in the house, providing the sources of such disturbance be properly watched. Two or three dollars' worth of sulphate of iron, or twice that amount if expended in nitrate of lead, used a little every day during the summer, must tend to kill the germs of disease.

The ventilation of a house from the cellar is thought by some who have carefully studied the subject to be unwholesome. The argument is that since the cellar is nearer to the dangerous ground, we take this vitiated air and allow it to permeate the house. It would be impossible in ninety cases in the hundred to isolate the cellar from the rest of the house, though it is attempted in some cases. The only true method is to keep the cellar perfectly clean in summer, and to watch carefully all pipes and drains leading into it. It is there mostly that the hygiene of the house is to be attended to, for no amount of precaution above will prevent the danger which exists below.—*New York Times.*

OZONE IN RELATION TO HEALTH.

Ozone is a most powerful oxidizing disinfectant, and it is so in virtue of possessing the power of resolving and decomposing all animal and vegetable putrescent matter into primitive and innocuous forms. A stream of ozone passed through a mass of black, offensive and putrescent blood, effects a change in it as if by magic; immediately, almost as soon as the operation has commenced, all disagreeable odor is removed, it resumes its florid red color, and coagulation is restored. The products of putrefaction are, as no doubt you are aware, not only favorable to the development of special poison germs, but such products also, by their continued action, prevent the proper oxidation which should go forward in the various tissues of the body, thus causing a predisposition to the action of any poisoned germs to which the body may be exposed. If ozone be diffused through apartments or elsewhere, it not only disinfects, by removing noxious vapors and poison germs, whatever their character may be, but, being itself in the gaseous form, it is inhaled during respiration, and, passing into the blood through the lungs, it oxidizes the used-up and effete matters produced during assimilation and the renewal of the various tissues, thus effecting in no inconsiderable manner a certain resistance to their pernicious influence if retained within the human body.

There has been much discussion as to what the precise nature of disease germs may be; but be they in the form of bacteria, or of any other form, ozone is potent for their destruction. . . . There are other competing disinfectants, such as iodine, chlorine, bromine, etc., but it has always appeared to me that we have in ozone Nature's own provided disinfectant; and, although I admit that artificial states often require the application of means correspondingly artificial, yet, by keeping on Nature's lines, using the very means she herself makes use of for the maintenance of life, the continuance of health, and for rendering innocuous the products of the functions of life, we are more likely to effectually attain the object in view than by making use of any other means whatever. The always and everywhere present oxygen needs no expensive process for its production, while its conversion into its most active condition, in the shape of ozone, may be arrived at by means so simple and so inexpensive that, on these grounds, if on no other, it stands, at least in my estimation, as the best, the safest, and least objectionable of all disinfectants. Lastly, ozone admits of being administered as a remedy for disease, and is, indeed, so administered in the form of ozonized oil, ozonized ether, and ozonized water. Here it ranks with remedies containing chlorine, bromine, and iodine. Whether in any respect it may, as a remedy, prove to have greater advantages than any, or all, of these agents, must be arrived at by determining whether it will do what the others cannot do. This, of course, can only be clearly and decisively made out by applying to it the test of an inductive philosophy—a rigid exclusion of all that is ineffective.—*Sanitarian.*

A NEW ANTISEPTIC.

A new antiseptic agent has appeared in Germany, which, if the statements regarding it are true, is one of the most important yet discovered. It is a double salt of borate of potassium and sodium, and is made by dissolving in water equal quantities of chloride of potassium, nitrate of sodium, and boracic acid, and evaporate to dryness after filtering. Its cost is about 25c a pound, and its use in foods, etc., does not in the least injuriously affect them, and gives no taste or smell to substances. It has been extensively employed already by butchers, sausage makers, tanners, etc.; but its most important use at present is in the manufacture of butter and cheese from sweet milk. When butter is made from sweet milk in the ordinary manner, the milk must be kept very cold; when the "preserving salt," as it is called in Germany, is used, the milk may be kept at ordinary temperature without souring; the remaining milk may be worked up into a superior quality of cheese. If fifteen grains of the salt are added for each quart of milk, the latter will keep sweet for at least a week. Fresh meat, game, etc., may be preserved by dipping it into a solution of one pound of the salt in six pints of water. When the meat is intended to be kept for a long period, it is rubbed in well with the powdered salt in the proportion of one and one-half drachms to each two pounds of meat. In twenty-four hours the impregnation is completed, and it only needs to be dried. A piece of meat prepared in this manner in January, 1877, was in perfectly good condition in January, 1879. For pickling, the meat is prepared in the same manner, and then placed between two layers of a mixture of two pounds of common salt, one-half pound preserving salt, and one-fourth pound of sugar. In this way the largest hams can be salted in four days. For preserving skins, from one-half to two pounds are used, according to size. Eggs are placed for fifteen minutes in a solution of one ounce of the salt in a quart of water. To preserve beer, wine, etc., it is sufficient to rinse the bottles, previous to filling them, with a solution of the salt in the proportion of one to ten, and adding to the beverage itself eight grains per quart. For fish, lobsters, oysters, fruit and vegetables, the preparation has also been use with the best success.—*Boston Journal of Chemistry.*

PETROLEUM IN AFFECTIONS OF THE CHEST.

Dr. Blache states, in the *Bulletin de Therapeutique*, that a refiner of petroleum having been prohibited by a préfet, at the request of some *pharmaciens*, the distribution of petroleum in medicinal doses, this led to an inquiry being made as to its alleged utility in affections of the chest. The native petroleum from Pennsylvania and Virginia was that experimented upon first. It is a very safe substance, for even large quantities, when drunk by error, have caused only a little nausea. In chronic bronchitis, with abundant expectoration, it rapidly diminishes the amount of the secretion and the paroxisms of coughing, and in simple bronchitis

rapid amelioration has been obtained. Its employment in phthisis has been continued for two short a time as yet to allow of any opinion being delivered as to its efficacy, beyond that it diminishes the expectoration, which also loses its purulent character. The petroleum is popularly taken in doses of a teaspoonful before each meal, and, after the first day, any nausea which it may excite in some persons disappears. M. Gardy, a Paris *pharmacien*, has prepared capsules, each containing twenty-five centigrammes of petroleum, or, as he calls it, *huile de Gabion*, from the name of an ancient petroleum spring, and this Dr. Blache considers as the most favorable mode of administering it.

CURRENTS OF AIR AS AFFECTING HEARING.

Jacques has studied the effect produced by the motion of the air in an auditorium upon its acoustic qualities, using for his purpose the Baltimore Academy of Music. Having proved by direct experiment that variations in density in the air transmitting sound not only decrease materially the intensity of the sound, as Tyndall has experimentally shown, but also actually modifies its form, and thus give rise to confusion and indistinctness, it naturally followed that in public halls where such currents of air really exist in abundance there must be much difficulty from this cause. In the building above referred to, the whole supply of fresh air is admitted at the back of the stage, is there warmed, then crosses the stage horizontally, passes through the proscenium, and diagonally upward toward the roof, across the auditorium, in one large current, and goes out partly through the roof and partly through the registries in the gallery ceilings, into a ventilating tower over the chandelier, whose heat is the motive power. About 15,000 cubic feet of air per minute are thus drawn through the house. The acoustic qualities of the house, being exceptionally perfect, are ascribed largely to the condition of the air within it. To test the question, experiments were made by stationing persons in various parts of it during a performance, and asking them simply to note the comparative ease with which the performers could be heard. At various intervals the valves controlling the circulation of air were reversed, so as to produce currents. Almost invariably the testimony was that at times, which proved on comparison to agree with those at which the reversals had taken place, the sound was confused and indistinct, and people all over the house were seen to make an effort as if to listen.—*Editor's Scientific Record, in Harper's Magazine for June.*

PAIN AND THE WEATHER.

In his paper on the Relation of neuralgic pain to Storms and the earth's magnetism, read before the National Academy of Sciences, Prof. S. Weir Mitchell reported the following observations:

Captain Catlin, U. S. Army, lost a leg during the war, and since that time

has suffered from traumatic neuralgia, sometimes in the heel, but more frequently in the toes, of the foot. He has carefully noted the effects produced on himself by changes of the weather. Dr. Mitchell's own studies in this case, as he says, "would never have proved successful had it not been for the unusual ability, interest in the task, and perseverance of the accomplished gentleman who has obliged me by making his own tortments useful in the solution of the question of how far weather effects the production of certain kinds of pain." The hourly observations cover a period of five years. "For the first quarters of these five years there were 2,471 hours of pain; for the second quarters, 2,102 hours; for the third quarters, 2,056 hours, and for the last quarters, 2,221 hours. The best yield of pain is in January, February and March, and the poorest in the third quarters, July, August and September. During these five years, while the sun was south of the equator, there were 4,692 hours of pain, against 4,158 hours while it was north of the equator; and the greatest amount of pain was in the quarters beginning with the winter solstice, and the least was in those beginning with the summer solstice. The average duration of the attacks for the first quarters was 22 hours, and for the third quarters only 17.9 hours.

By taking the four years ending January 1, 1879, it is found that of the 537 storms charted by the Signal Bureau, 298 belong to the two winter quarters, against 239 for the summer quarters. Hence we have the ratio of the number of storms of the winter quarters and summer quarters corresponding to the ratio of the amounts of neuralgia for these respective periods, and the ratio of average duration of each attack for the same time corresponds closely with the ratio of the respective total amounts of neuralgia for the same periods The average distance of the storm center at the beginning of the neuralgia attacks was 680 miles. Storms coming from the Pacific coast are felt farthest off, "very soon after, or as they are crossing the Rocky Mountains," while storms along the Atlantic coast are associated with milder forms of neuralgia, and are not felt until the storm center is nearer. Rain is not essential in the production of neuralgia.

It was found that the severest neuralgic attacks of the year were those accompanying the first snows of November and December. One of the most interesting and valuable results of this series of observations is thus stated: "Every storm, as it sweeps across the continent, consists of a vast rain area, at the center of which is a moving space of greatest barometric depression, known as the storm center, along which the storm moves like a bead on a thread. The rain usually precedes this by 550 to 600 miles, but before and around the rain lies a belt which may be called the neuralgic margin of the storm, and which precedes the rain about 150 miles. This fact is very deceptive, because the sufferer may be on the far edge of the storm basin of barometric depression, and see nothing of the rain, yet have pain due to the storm.

SCIENTIFIC MISCELLANY.

THE CERAMIC ART OF JAPAN.

W. E. GRIFFIS.

The first historic notice of the ceramic art in Japan is that of the terra-cotta figures set in the earth in a circle round the dead, in place of the living victims formerly buried up to their necks. After death by starvation, a circle of skulls marked the site of the illustrious dead, like the cairns of Britain. Ancient graves, occasionally opened in the vicinity of Nara and Kiōto, are found surrounded by a circle of clay images. At the death of the wife of one of the ancient mikados, who had been grieved at hearing the groans of the dying victims buried alive to their necks with the dead Prince Yamato hiko no mikoto, he permitted his adviser to bring a hundred workmen in clay from Idzumo, who made clay images of men, horses, and other things, which were buried in lieu of men with the empress. Potters, brick and tile makers, came over from Corea with other artificers in the seventh century, and in A. D. 724 progress in the ceramic art began by the introduction of the potter's wheel, and continued for five centuries in the working of faience only, pure Japanese porcelain being unknown till the time of Hidéyoshi. In the days of the Hōjō Kato, Shirozaëmon having visited China to study the art, came back and erected his wheels and kilns in Séto, Owari, making, however, only pottery of an improved sort. "Séto-mono" (Séto ware, or séto, like our term "china") is the common name for household crockery in Japan. The making of real porcelain in Japan was begun by the Corean potters brought into Japan by the Japanese who invaded Corea (1592–1597). These captives were settled in Buzen, Higo, Hizen, Ozumi, and Satsuma, in Kiushu, where are still the oldest seats of the ceramic industries, and at Yamaguchi, in Nagato, and near Kiōto. About the same time a Japanese from Isé, who had studied the clays, pigments, and methods of the Chinese, settled in Hizen, where he found beds of clay of the varied qualities necessary to produce the famous Hizen wares. It is only in very recent times that the potteries of Owari, Mino, and Kaga have become celebrated; and those near Tōkiō and Yokohama only within the last decade At present it is notorious that the "old" Satsuma. Hizen, and Kiōto wares are imitated in scores of kilns all over the country. Very few pieces of the highest artistic merit have been produced since the Restoration, as the making of porcelain and faience in Japan has since 1868 degenerated from an art to a trade. In the days of feudalism, masterpieces of the ceramic art were made for princes and lords, for presentation to fellow-daimiōs, the shōgun and court nobles. Such things were not bought and sold. There were, properly speaking, no shops for

their sale. Only household crockery was seen in the shops. Fine pieces were not in the trade, a fact which explains what foreigners have so often wondered at, namely, that until eight or ten years ago, the rarest porcelain was made in Japan, and occasionally found its way to Europe, yet the keenest-eyed visitor never saw it on sale Formerly the artisan was an artist, and worked for low wages and honor. He lived on a few bronze cash per day, yet enjoyed the presence and friendship of his lord. The daimiō visited the potter at his wheel, and the potter sat in honor before his master on the mats of his palace—a place in which the richest trader in the province could not so much as enter. To imprint his stamp, or to scratch with his little finger-nail his name or mark on the bottom of a tea-bowl, or "clove-boiler," or vase over which he had spent a year or three years, and which should adorn for generations the *tokonoma*, or nooks of a daimiō's chamber, was sufficient reward to the workman already proudly happy in his own work. Of this contented happiness in work which found its reward in honor, not gain, I was more than once a witness. It is to be hoped that the government and native art-lovers, and the proper foreign influence, will be able to arrest the downward tendency of Japanese art in ceramics, and restore it to its former glory, even though the social atmosphere and environment are now so wholly changed.

The villages in which faience and porcelain are made, whose names are household words in America and Europe, look like any other Japanese villages. In the dingy, weather-beaten cottages, made of wood, mud, reed, and thatch, the potters work before their paper windows, the force in each "establishment" usually consisting of father and son, rarely of more than three or four men. The kiln or kilns are the common property of a village, built up the sides of a hill, and fired with pine wood, the workmen taking turns in noting the temperature and watching the melting of sample enamels on bits of clay set near the plug-holes.

Often the biscuit is made in one place, and the glazing done at another. Many potters now sell their baked wares to artists in Tōkiō and the large cities, who lay on the colors, decorate, and fire in their own furnaces—a process I have often watched in Tōkiō. New designs are wrought by the artist from a drawing, but stock subjects are laid on from memory, and for the cheaper wares dabbed on. In the potteries the principle of division of labor is well understood, one man making bodies, another spouts, another handles or ears, his specialty. Of late years companies employing capital have centralized labor, and collected workmen in large establishments, improving their fortunes, and, in rare cases, improving the art.

Japanese porcelain or faience takes its name from the name of the trading town, the place of manufacture, the port whence it is shipped, the name of the province, or the place where it is decorated. The following ware is the most celebrated:

SATSUMA.—The oldest specimens have no colored decoration, and date from about 1624, those of the latter part of the century being but slightly adorned in

colors. From the beginning of the eighteenth century appear figures, landscapes, and the general style of decoration in gold and bright tints called *nishiki* (flowered silk, or brocade) The rich gilding, the harmony of colors, and the delicacy of drawing, have united to give "old Satsuma" which is mostly in small pieces, its renown. Most of it is crackle, called *hibiki* (snake porcelain), the cracks imitating a serpent's skin. The body of nearly all fine Satsuma ware is white, or cream, or buff color, though red, green, chocolate, purple, blue, white, and black glazes, made of native minerals and metallic oxides, are used. All sorts, qualities and colors are now made and exported from Satsuma. Nearly all Satsuma ware is faience, semi-porcelain, or stone-ware—not true porcelain.—*The Mikado's Empire.*

PROGRESS OF ELECTRIC LIGHTING.

While the sensational reports in regard to electric illumination have subsided, the electric light is making friends in various quarters. The Waltham Bleachery, Mass., have been using two generators of the Wallace-Farmer pattern. Ten lights supply 112 four-foot gas burners. The generators require twelve horse power apiece, and the horse is estimated at one cent per horse power per hour. It is stated that the quality of the light is good; no complaint is made of its flickering. Washburn & Moen of Worcester, Mass., use the Brush electric light to a limited extent, lighting but a portion of their works. They state that they get much more light from gas for an equal expenditure of money. No accurate experiments, however, have been made.

The Riverside Mills, of Providence, R. I, employ two Brush generators. One machine has been running about two months in a weaving room, and part of the rest of the mill has also been lighted with electricity. These mills runs night and day, and use a large number of gas burners from 10 to 12 hours per day, and, therefore, are peculiarly well fitted for the employment of the new light. Twenty electric lamps have taken the place of 230 five foot burners in a weaving room, and give a better and more satisfactory light The work requires an unusually strong illumination.

The lighting of the Boston Music Hall by electricity has been postponed until a larger machine of the Brush pattern can be completed. In the preliminary trials it was found that the light would be unpleasant to a general audience, and it is, therefore, proposed to modify its color and brightness by the employment of suitable glass or porcelain shades.

W. Mattieu Williams, F. R. A. S., in a recent paper gives an interesting resumé of early English experiments on incandescence, particularly those of Mr. Starr. The latter devised a peculiar method of winding the conductors of a dynamo-electric machine. Since the thick copper wire, usually made use of, necessarily is wound on the armatures in a spiral, there is a certain loss of compactness, and an increase in resistance, which Mr. Starr proposes to obviate by

using a core of square section, and winding around it broad ribbons of sheet copper, which was insulated by cementing on its surfaces a layer of silk ribbon. This ribbon is to be laid with one edge against one side of the core and carried on until the angle, then it is to be turned over so that its opposite edge may be laid along the next side of the core, and so on. It seems as if this method of winding dynamo-electric machines would have certain obvious advantages. The experiments of Starr, however, on lighting by incandescence did not result in much successs, and they were unfortunately brought to an end by the untimely death of the inventor. Prof. Williams, who has devoted much attention to the manufacture of gas, believes that there is a greater field for invention in gas manufacture than in the field of electric illumination. The by-products, ammoniacal salts, liquid hydrocarbons, and coke, are sufficient, in his opinion, to cover the whole cost of manufacture of gas, and leave gas itself as a volatile residuum that costs nothing. He thinks that gas might be delivered to consumers in London at one shilling per thousand cubic feet "if gas making were conducted on sound commercial principles—that is if it were not a corperate monopoly, and were subject to the wholesome stimulating influence of free competition and private enterprise" He, therefore, thinks that any comparison of the two methods of illumination based upon the present cost of gas is essentially misleading, for future invention can materially reduce the price of gas.

Prof. W. E. Ayrton also takes up the subject of electric lighting by incandescence, and proves that the electromotive force necessary to be maintained at the two ends of a wire of platinum, five centimeters in length and one millimeter in diameter, and at the ends of a piece of carbon, two centimeters in length and one millimeter in diameter, is 0.2848 volt, or about one-third of a Daniell's cell in the case of the platinum, and 0.46013 volt, or about one-half that of a Daniell's cell in the case of the carbon wire. It is, therefore, possible to produce a light with an electromotive force less than that of a Daniell's cell, but not with a Daniell's cell itself, since the internal resistance of the cell is far greater than that of the incandescent wire or rod of carbon. He was enabled to use the method of incandescence in 1873, when the government was employing divers to recover the property sunk in the French mail steamer Nil, off the coast of Japan. An ordinary carbon rod was first scraped very thin, and then, with connecting wires affixed, it was placed in a vacuum globe, and by heating it with an electric current, and passing air through the globe, it was burnt to the required degree of thickness; the current was then stopped and the air pumped out and replaced by nitrogen. The agitation of the subject of electric illumination certainly will provoke inquiry into the subject of the cost of gas, and, therefore, ought to be encouraged.

THE electric light is about to be introduced into two or three London churches. It is also largely employed at Westgate-on-Sea, upon the extensive estates of an English gentleman who is interested in comparing the relative cost

and advantages of electric light and gas. Along the pretty sea-frontage of Westgate are arranged rows of electric and gas lamps, the one to illuminate the broad marine parade and drive, with the tasteful villas and terraces, and the other to light up the ornamental gardens and promenades Notwithstanding the semi-opaque globes absorbing some sixty per cent of the brilliant white electric light, the adjacent gas lamps appear in contrast to burn dimly, with a smoky, dull, dirty amber-yellow flam .—*Scientific American.*

PROPAGATING RARE PLANTS.

BY THOMAS LAWRENCE, OGDENSBURG, N. Y.

There may not be anything new in the following method of propagation; still as I never saw or heard of it before hitting on it, I thought there might be some of your readers like myself.

It is nearly always desirable to increase new plants, and plants of slow growth, faster than they furnish wood for the purpose. It can be increased from two to ten fold by commencing at the point of a well established plant, and splitting it downward an inch or more according to its nature and growth, leaving it in that condition for a day or two. Then commence at the point of these halves, and split them down into quarters. Leave them from two to ten days to callous, when each quarter will make a cutting almost certain to grow, even if cut into single eyes. As soon as the cuttings have rooted, been potted and well established, split them also half their length, and in a few days more continue the split down to, and through the roots, making two or more plants instead of one. I find it advantageous with tricolored geraniums, double primulas, etc. It does not endanger the life of the parent plant for they can be taken off a few at a time, thereby lessening the shock that would occur to some plants if the whole top were taken at a sweep. The parent plant goes right on growing without the necessity for repotting. The young growth of most hard wooded plants might be facilitated in the same way. There is no rotting in the cutting bench as is often the case with whole cuttings of tricolor geraniums, poinsettas, etc.—*Gardener's Monthly.*

THE CELEBRATED "CARBONATES" OF LEADVILLE.

The ore found here is carbonate of lead, carrying silver. The only form in which the silver is recognizable is that of chloride of silver, which is sometimes seen as a thin layer of yellow wax-like substance on the surface of the hard carbonate ore. Generally the silver is so intimately associated with the lead that it is impossible to determine its form. In the furnace equal parts of charcoal and coke are used for fuel, and iron ore and limestone, and sometimes the slag from the smelter, are used for flux. At the smelting heat the oxide of lead, which is an extremely unstable compound, surrenders its atom of oxygen, which unites

with the carbonic oxide, and forms carbonic acid, setting the lead free. The chemical process with the silver is not known, except when it is in the form of a chloride, in which case the chlorine is volatilized. The silver and lead, being heavier than the substances held by the flux, then sink into a well at the bottom of the furnace, from which they are ladled into molds that hold about 100 pounds of the base bullion, while the slag floating on top is drawn off through a higher channel into heavy conical coolers, and emptied in sugarloaf cones on the dump. The carbonates are hard and soft, the hard varying in color from that of gray limestone to dark slate, and the soft from a deep cream to a rich dark brown. The hard is a dense, firm rock of great hardness, requiring powder to remove it; the soft is sometimes of the consistency of chalk, that can be crushed with the fingers, or in the form of a coarse sand, and can be mined with pick and shovel. The presence of masses of galena in the vein is not infrequent, and in such relation to the carbonates as to lead to the belief with some that the carbonates are the result of a change from sulphurets to carbonates by the action of water or air.—*Cor. Globe Democrat.*

LEATHER PAPER.

The *Leather Trades Circular* says: The idea of utilizing scrapings and other leather waste has always been a favorite one with inventors; and so far back as 1786, Mr. Samuel Hooper obtained a patent for the manufacture from leather or leather cuttings, or parings, of a material for covering carriages, trunks, etc., and for making hat and band boxes, tea-trays, etc., and also in the manufacture of different kinds of paper from leather. For making the new material, the leather was washed clean, and then worked with a proper quantity of water till it was reduced to a pulp. When necessary, size was used. The pulp was next placed in molds and exposed to a pressure necessary to give it a smooth and even surface. It was also passed between iron and brass rollers. For making hat and band boxes, the process was the same, except that when the leather was reduced to a pulp it had to be freed from all water and mixed with strong size. It then attained the consistency of thick paste, and could be molded in any required form. For making paper, the leather was reduced to a pulp in the manner before described. If brown paper was wanted, a fourth part of junk or hemp, with a little fine clay, was mixed with the pulp. For whitey-brown paper, the coarsest rags were used instead of junk and clay. For white paper, three parts of fine rags and some size had to be added to the leather. The paper was manufactured from the pulp in the ordinary manner.

XUM

THE GREAT SPIRIT SPRINGS OF KANSAS.

These springs, located about three miles from Cawker, to the southeast, are great natural curiosities, and in the future will undoubtedly be a great place of resort. Approaching them from any direction you find paths pointing toward them, now nearly overgrown with grass, made by buffalo in going to them, for salt, no doubt, when this now almost extinct animal roamed so extensively and supremely over this region. The spring, which is a general term for what is actually a mound, in the top and center of which is a basin of perfectly clear water, is about the most unexpected thing to find here that can be thought of. The mound is some sixty feet in diameter, twenty feet high, and almost circular in shape, with oval top. The water from the basin does not flow over the top now, although it may have done so in the past, but comes out on the south side in a clear little basin, where the drinking water is obtained. The basin on top of the mound is said to be very deep, almost fabulous, in fact, but, I am confident, highly exaggerated. Water oozes out on the sides of the mound in a few places only. A little dry ravine comes in on either side of the mound (I must say spring), making it an island in fact, or it would be an island if there was any water in the ravine. There are many theories as to how the spring came to exist in this shape, one of which is that by continued overflow for hundreds of years, the water leaving a deposit of lime, gradually rose at the rim, and flowing over, caused the almost gradually sloping or circular sides. From my observation I am convinced that such is not the case, as the rock, of which the mound (spring) consists entirely, is in stratified form, each stratum being almost level and apparently running from side to side. The water has a brackish, salty taste, much resembling in taste that from the Iola wells. It is said to have many curative principles, and has been used here to some extent by physicians.—*Cor Kansas City Times.*

BOOK NOTICES.

ADULTERATION OF FOOD AND MEDICINE. By Edward R Squibb, M. D., Brooklyn. G. P. Putnam's Sons, New York. Kansas City Book and News Co.; 25c. Pp. 57.

This is Number XIV of the "Economic Monographs," and is an argument in favor of a bill providing for general State Legislation on this important subject, together with notes in reply to criticisms by the press. The importance of such a law is manifest, and Dr. Squibb has brought it forward in the shape of an act already prepared for presentation to the legislatures of the various States, with such explanations and illustrations as his wide experience has suggested to him. The subject deserves the prompt attention of law-makers and good citizens generally.

QUARTERLY REPORT OF THE KANSAS STATE BOARD OF AGRICULTURE. Alfred Gray, Secretary. Topeka: Geo. W. Martin. Pp. 77, octavo.

As we have had occasion several times to say, these Reports are doing more good for Kansas than any other means she could adopt to inform the people of the country and the world of the wonderful resources of that state, and Secretary Gray has shown and is showing an admirable fitness for the position he holds.

The number under notice contains chapter after chapter of the most valuable and suggestive statistics relative to industries, population, natural resources, etc, by counties, and is just what any intelligent immigrant needs in making up his mind it what portion of the state to settle down.

LEADVILLE AND TEN-MILE. Stephen F. Smart. Kansas City: Ramsey, Millett & Hudson; 50c. Pp. 56, octavo.

The above named book is by far the most comprehensive and accurate we have yet seen on this subject. Mr. Smart is a writer of unusual vigor and clearness, and has already done much, through his various writings, to direct attention to the resources of Kansas and Colorado. The present work on the Carbonate Camp of Colorado, bears evidence of more than usual care in its preparation, and is replete with accurate and highly valuable information concerning the remarkable mines at Leadville and the more recent discoveries at Ten-Mile, Eagle River, Elk Mountain and the Gunnison country. Among other important features, we notice a carefully prepared glossary of mining terms, a list of the important mines at Leadville, together with the prices at which many of them were bonded or sold; a table of the average yield per ton of the Leadville mines; a table of the important discoveries at Ten-Mile; advice to prospectors; cost of sinking shaft, and much else of great interest to persons who have an idea of going into the Carbonate Camps, or who desire to know their characteristics. The book also contains two accurate maps and a summary of the national and state mining laws, and rules of the national Land Department.

Taking it altogether, "Leadville and Ten-Mile" is the most valuable contribution to the literature of the Carbonate country which has yet appeared, and will be eagerly sought for by the thousands who have read Mr. Smart's previous works.

The book is being printed by Ramsey, Millett & Hudson, which is a sufficient guaranty of its typographical excellence.

A note just received from Prof. J. D. Dana, of New Haven, calls our attention to an error of quotation, by Mr. Edmunds, in his article in the May number of the REVIEW, page 32, where he erroneously uses the word *man* in a quotation relative to the cretaceous saurians. Prof. Dana says he "supposes he ought to laugh at it as a joke," but at the same time regards it as "not pleasant to be misrepresented even for the amusement of others."

EDITORIAL NOTES.

THE Lecture of Professor Marshall, on the 9th of May, at the Opera House, upon the National Yellowstone Park, was a most entertaining and instructive one, and was attended by a good audience. The Academy of Science has thus far been very fortunate in securing the services of eminent and popular lecturers at its public entertainments, so that hereafter there will be no difficulty in calling out full houses on such occasions.

THE Anthropological Society of Washington has recently been organized with Major J. W. Powell, as President; Elmer J. Reynolds, Recording Secretary, and Prof. Otis T. Mason, Corresponding Secretary, to whom communications may be addressed and specimens sent.

PROFESSOR RILEY, after an extended series of tests, finds that the mulberry may be entirely dispensed with, and the leaves of the osage orange, a very common hedge plant in sections where the climate is favorable to the silk worm culture, may be substituted without any danger of impairing the result.

THE *American Chemical Journal* is a new periodical edited by Professor Remsen, of the Johns Hopkins University at Baltimore, Md. It will be devoted to pure chemistry but will also contain reports by eminent chemists on particular branches of this science.

Harper's Monthly commences its 59th volume with the June number, and this beginning is signalized by a general and permanent improvement—increasing the size of the type and the width of the page, both of which changes add to the beauty of the work, while the remarkable excellence of its engravings is a feature which, in our judgment, renders it preëminent among the numerous illustrated magazines of the day.

THE success quietly attained by the *Library Table* during the past three years has induced the publishers to issue it Weekly instead of Fortnightly as heretofore. It is their purpose now to push the *Library Table* forward to its proper place among the leading journals of the country. It has been increased to 32 pages and enlarged slightly in form. Its high literary character will be maintained,—viz: its Signed Articles by leading writers on the principal books published, critical notes and comments, "Briefs" on important volumes freshly issued, and the most recent intelligence concerning the makers and making of books—and several new departments will be introduced. The enlarged size and scope of the paper will permit the discussion of important political questions. "Notes of the Week" will be bright, trenchant comments on current events. "Contributors Miscellany" will contain piquant sayings, odd conceits, poems, reminiscences. A department of Notes and Queries will be introduced, and greater space given to the departments of Music, Drama and the Fine Arts, which will hereafter be conducted by competent specialists. There will also be a weekly article on the Stock Market, and particular attention will be given to the great Financial and Industrial interests of the country.

THE Santa Fe *New Mexican* says: A specimen of the handiwork of the ancient Spanish miners inhabiting this Territory was brought to town from the Cerrillos mines a day or two since, and is now on exhibition at the office of Gen. Atkinson. It is a casting from what seems to be pure silver, and is, taking a front view, in the shape of a crown. At the base it is two and one-half inches thick, at the top two inches, and at the sides one and one-half inches. Its greatest width is six and one-half inches, and from the top to the bottom six inches. Its weight is nine pounds and fourteen ounces. If pure silver, its intrinsic value is about $150, but there is supposed to be some gold in it, which, of

course would add to its value. This remarkble ingot was discovered under a boulder about half a mile to the southeast of the celebrated Turquise mine, in the midst of the new discoveries. It must have lain there at least since 1680, as no working in these mines was done by the Spaniards after the uprising of the Indians during that year.

A DEADLY disease has broken out in the Caucasus which proves fatal in twenty-four hours. In Derby, which contains 150 houses, seventy persons died. In Medivrichevi, with 200 houses, there are 200 persons dead. The mortality elsewhere is on the same scale.

THE National Academy of Sciences has just held its annual session in Washington, with Vice-President Marsh in the chair. In his opening address he paid a feeling tribute to Professor Henry, the late President of the Academy, and reviewed the work of the Academy for the past year. Among the papers read the following have the more general interest: The Relation of Neuralgic Pain to Storms and the Earth's Magnetism (S. Weir Mitchell); Oxygen in the Sun (Henry Draper); Vowel Theories based on Experiments with the Phonograph and Phonautograph (R. G. Bell); Eclipses of Jupiter's Satellites (E. C. Pickering); Errors of Pendulum Experiments, and a Method of Swinging Pendulums, proposed by M. Faye (C. S. Peirce); Report of Progress of the International Bureau of Weights and Measures (J. E. Hilgard); and Critical Remarks on Observations alleged to be of Intramercurial Planets (C. H. Peters). Professor William B. Rogers, "the Nestor of American Geology," was elected President of the Academy, to succeed the lamented Henry, and the old officers were reëlected.

WE learn from the London *Iron Journal*, that the Missouri Lead mining and Smelting Co., under an agreement of 8th ult., proposes to purchase from the Virginia Lead Mining Co., of Franklin, in the State of Missouri (U. S. A.), and from Messrs. Nathaniel Sands, Francis Albuquerque Sands and George Hopkins, the Virginia Mine, the Piney Mine, and the St. Clair Mine, situate in the above State. The company was registered 17th ult., with a capital of £90,000, in £10 shares, of which 4500 will be A or preference shares, bearing a preferential dividend of 10 per cent.; the remaining 4500 will be styled B or ordinary shares. The purchase includes all appurtenances of the said mines. The consideration for the Virginia Mine is £60,000, payable £15,000 in cash, and the remainder in fully-paid B shares. For the sale of the Piney Mine, Mr. F. A. Sands is to receive £3000 in cash. The consideration of the St. Clair Mine is the payment to Mr. N. Sands of £2000 in cash.

MESSRS. LINDSAY & BLAKISTON, of Philadelphia, are issuing a series of 16mo. Health Primers, written by some of the most experienced and distinguished physicians of Boston, New York and Philadelphia, and edited by Dr. W. W. Keen, Fellow of the College of Physicians. The subjects, as far as announced, are: Hearing, and How to Keep It; Long Life, and How to Reach It; Sea Air and Sea Bathing; The Summer and its Diseases; Eyesight, and How to Care for It; The Throat and the Voice; The Winter and its Dangers; The Mouth and the Teeth; Our Homes; The Skin in Health and Disease; Brain Work and Overwork

THE exportation of American coal to Europe, and especially to Mediterranean ports, has greatly alarmed the English producers of coal, who have heretofore supplied those countries. More than twenty cargoes of American coal have reached the Mediterranean within the past sixteen months, and a report has now reached London that an Italian firm has ordered a supply of 100,000 tons of coal from the United States.

ONE of the best articles of the season is that of Dr. George M. Beard, in the *Atlantic* for June, upon "The Physical Future of the American People," in which he develops the central idea that Young America finds itself contending with the combined disadvantages of youth, an exhausting climate, and the heightened activity demanded by the "fast-

ness" of the age, to meet which it has been and will be found necessary to seek out and develop numberless modes of physical exercise, and reduce the philosophy of enjoyment and recreation to a science and art.

This number of the *Atlantic* closes the 43d volume, and may be classed as one of the best in its long history.

TO THE pessimistic rationalists of the present day, who find nothing to admire or to hope for in this world, we commend the following lines from an old poem, by Morris, entitled the "Epic of Hades:"

"For while a youth is lost in soaring thought,
And while a maid grows sweet and beautiful,
And while a spring-tide coming lights the earth,
And while a child and while a flower is born,
And while one wrong cries for redress and finds
A soul to answer, still the world is young."

THE commencement exercises of the University of Kansas will be held June 6th to 11th. As our citizens are nearly if not quite as directly interested in this institution as in the University of our own state, and it is so easy of access, a very considerable attendance from this city might reasonably be expected.

THE endowment of the Celtic Chair at Edinburgh University is nearly completed. The sum of $59,810 has been collected, and only $190 is now required. No actual appointment to the professorship will be made before the spring of 1880. Practical instruction in Gaelic will be one of the duties of the chair as long as that language shall be a recognized medium of religious instruction in the Highlands.

DR. ISAAC HAYS, for fifty-two years editor of the *American Journal of Medical Sciences*, died April 13th. He was born in Philadelphia July 5, 1796, and was the oldest living editor in continuous service in America.

THE *Exporter and Importer*, published monthly by E. W. Fox, long a prominent and popular business man of St. Louis, is just such a journal as is demanded for the development and extension of domestic and foreign trade, between the great interior basin of the United States and other states and countries. It is a 32-page quarto, handsomely printed, and it starts off with an enthusiasm and breadth of scope which, if properly maintained and supported, will cause it to become an important agent in accomplishing the above named objects.

THE *Western Homestead* closes its first volume with the May number, and Major Burke is to be congratulated upon the success he has met with in inaugurating and firmly establishing this excellent family magazine upon a paying basis the first year.

THE *Science News*, heretofore published by S. E. Cassino, at Salem, Mass., has been purchased by Wm. C. Wyckoff, and will henceforth be published fortnightly at New York, under the personal management of Messrs. W. C. Wyckoff and Ernest Ingersoll. It is a valuable journal, and very low at $2 per annum.

WE are indebted to Lieut. C. A. H. McCauley, Third Cavalry, U. S. A., for a Report of explorations made by him in and about Pagosa Springs, Colorado, in the year 1878. It is a most interesting and instructive description of the remarkable hot springs, as well as of the general physical and mineral features of the surrounding country, illustrated by careful and well executed drawings done by Lieut. McCauley himself. In a future number we shall place before our readers some of the more interesting chapters.

THE article on "Ice Caves," published in this number of the REVIEW, was in type for the May issue, but the cut illustrating it failing to arrive caused its postponement. Mr. Ritchie, of the Boston *Science Observer*, who has probably made the first thorough examination of the subject in America, has sent us an exhaustive article, which will appear next month. Mr. Ritchie is very desirous of further facts, and will be glad to have any observer communicate with him.